

Braun Vandewere PA

*NAVAJO SUPERFUND OFFICE*

NAVAJO - BROWN VANDEVER URANIUM MINE

PRELIMINARY ASSESSMENT REFERENCES

JUNE '90

P. MOLLOY

LEONARD HASKIE  
INTERIM PRESIDENT  
NAVAJO NATION

## THE NAVAJO NATION

IRVING BILLY  
INTERIM VICE PRESIDENT  
NAVAJO NATION

NSO-90-62

April, 06 1990


Mark Satterwhite  
Superfund Indian Coordinator  
U.S. EPA Region VI  
1445 Ross Avenue  
Dallas, Texas 75202

Dear Mr. Satterwhite:

Enclosed is the Preliminary Assessment (PA) Package for the Brown Vandever Uranium Mine, located near Bluewater, New Mexico. This report receives NSO internal approval and is now ready for your review and comment.

Please call myself or Patrick Molloy, the Health Physicist who prepared the package, for any questions you may have regarding the report. We would appreciate a response in the form of comments or approval at your earliest convenience. You may reach myself or staff at (602) 871-6859, 6860 or 6861.

Sincerely,



Clara Bia  
Navajo Superfund Director

Enclosures

cc: Peter Sam, William Taylor, Superfund Site Assessment Section  
Deborah Vaughn-Wright

PRELIMINARY ASSESSMENT FOR THE NAVAJO - BROWN VANDEVER URANIUM MINE

BY

PATRICK MOLLOY  
HEALTH PHYSICIST, NAVAJO SUPERFUND OFFICE

SUMMARY

The Brown Vandever Mine contains about 1880 tons of uranium mine tailings abandoned on-site. Small quantities of ore grade material are to be found scattered all over the site. The material is uncovered and easily accessible by site residents and visitors. There are several uncovered ventilation shafts, timbered shafts and inclined adits on the site. There are no warning signs or fences preventing access to the site.

The population affected directly by the site is at least 75 people, and could be as high as 500 people. Over thirty children are known to play on the tailings and in the immediate vicinity of the mine.

There is a haulage road on the site "paved" with tailings. Radiometric evidence indicates off-site migration of contaminants at least 2 mi from this road via automobiles driven on this road by area residents.

MAJOR CONCLUSIONS

The site has a status of immediately dangerous to life and health. Immediate action is recommended.

## PRELIMINARY ASSESSMENT

DATE : May 20, 1990

Prepared by: Patrick Molloy, Health Physicist, Navajo Superfund Office

Site : Navajo - Brown Vandever Uranium Mine

EPA ID # : Not assigned

### SITE INFORMATION

**Site Location.** The Brown Vandever Uranium Mine (Brown Uranium Mine, sic) is located approximately 4 miles east of Prewitt, New Mexico. The site is also located approximately 20 miles north-northwest of Grants, New Mexico (figure # 1). The site may be found by proceeding east from the Prewitt, New Mexico post office on the Interstate 40 frontage road approximately 1 mile and subsequently traveling east on an improved dirt road for approximately 5 miles (figure #2). The road turns north at the eastern edge of Haystack mountain, a prominent geological feature in the area. The site is located on the southeastern margin of Haystack mountain approximately 1 mile north of El Tintero cinder cone (figure #2). The Geographic coordinates for the site are 35° 21' 02" N latitude and 107° 56' 25" W longitude (7).

The mine is located on an expired mining claim of approximately 1/2 section in area. Approximately 65 persons, including small children live on-site in a semi-agricultural rural setting (3,4; worksheet #2, 7). Two inclined adits, an almost vertical timbered shaft, two vertical ventilation shafts and a strip mine covering approximately 100 acres are notable features of the abandoned claim (3; Frames).

**OWNER AND OPERATOR.** The Brown Vandever Mine is currently owned, and was owned throughout its history by the Navajo Nation (17). The land is held in trust for the Navajo Nation by the Federal Government through the authority of the Bureau of Indian Affairs (BIA).

The primary lease holders for the claim were variously; Williams and Thompson (full names not found) and Mr. Brown Vandever (2; pg 1-276, 3-5). The site was presumably subleased to the various operators (2; page 3-5). Several other mines are to be found in the area the most notable being the Haystack 2 mine (11). The lease is currently owned by the Navajo Nation (17).

**PURPOSE OF INVESTIGATION** The Brown Vandever Uranium Mine was reported to be a potentially contaminated waste site by the Navajo Superfund office field reconnaissance team in 1990 (1).

**SITE HISTORY** The Brown Vandever Uranium Mine is located in the Ambrosia Lake sub-district of the Grants Mining District (7,10). No Historical record for naturally occurring radiation levels for the area has survived until the present. Two inclined adits were driven north-northwestward into the dip of the Todilto formation (3; frame #12, figure #4). These inclines were reported to be approximately 300 ft. deep (14; page #6, direct quote): additionally, two 400 yd. drifts were driven into the ore bodies associated with the incline in Frame #12 (14; page #2).

A timbered shaft inclined at approximately 10° from the vertical, was driven into the dip of the Todilto formation approximately 1000 ft. west of the inclined adits (3; frame #33). This shaft was reported to be approximately 300 ft. deep (14; page #6): drifts were also excavated northwest and northeast from the shaft.

Two, two-foot diameter vertical shafts were excavated between the inclined adits and the timbered shaft in order to provide ventilation for the mining operation (3; frame #33); the ventilation shafts were reported to be approximately 300 ft. deep (Mr. Brown Vandever, personal communication, April 11, 1990).

The area south of the inclined adits has been extensively strip-mined: The area of surface disturbances has been estimated to be approximately 100 acres in extent (4; page # 8, Figure #2). Tailings associated with the N. and B. Vandever Mines were used to "pave" a road leading to the N. Vandever works.

It is presumed that the mining operation was carried out using conventional mining techniques; Due to the extensive and elaborate nature of the surface works and adits (shafts), it is unlikely that manual labor was utilized to any great degree. A powerline extension which was used to provide electricity for an air compressor still exists on site.

The Brown Vandever Uranium Mine was operated intermittently over the period of years from 1952 until 1966 (2). Santa Fe Uranium, Federal Uranium Mesa Mining Co. and Cibola Mining Co. were some of the mining interests involved: Other individuals operated the mine (2).

Mining operations at the site produced 25,796 tons of ore rich in Uranium ( $U_3O_8$ , 0.19% grade) and Vanadium ( $V_2O_5$ , 0.30% grade). A total of 98,175 lbs of  $U_3O_8$  and 75,342 lbs of  $V_2O_5$  were milled from the raw production tonnage (2, pg# 1-276, 3-5).

It is presumed that the ore was transported to Shiprock, New Mexico or Durango, Colorado for milling. However, no record of where the milling took place was found: It is not known whether the Phillips Petroleum Ambrosia mill was in operation during the time the ore was being produced.

**DISCUSSION OF KNOWN/POTENTIAL PROBLEMS** During a windshield survey of the site and environs, in order to ascertain population, population distribution, water usage patterns and area radiometric background

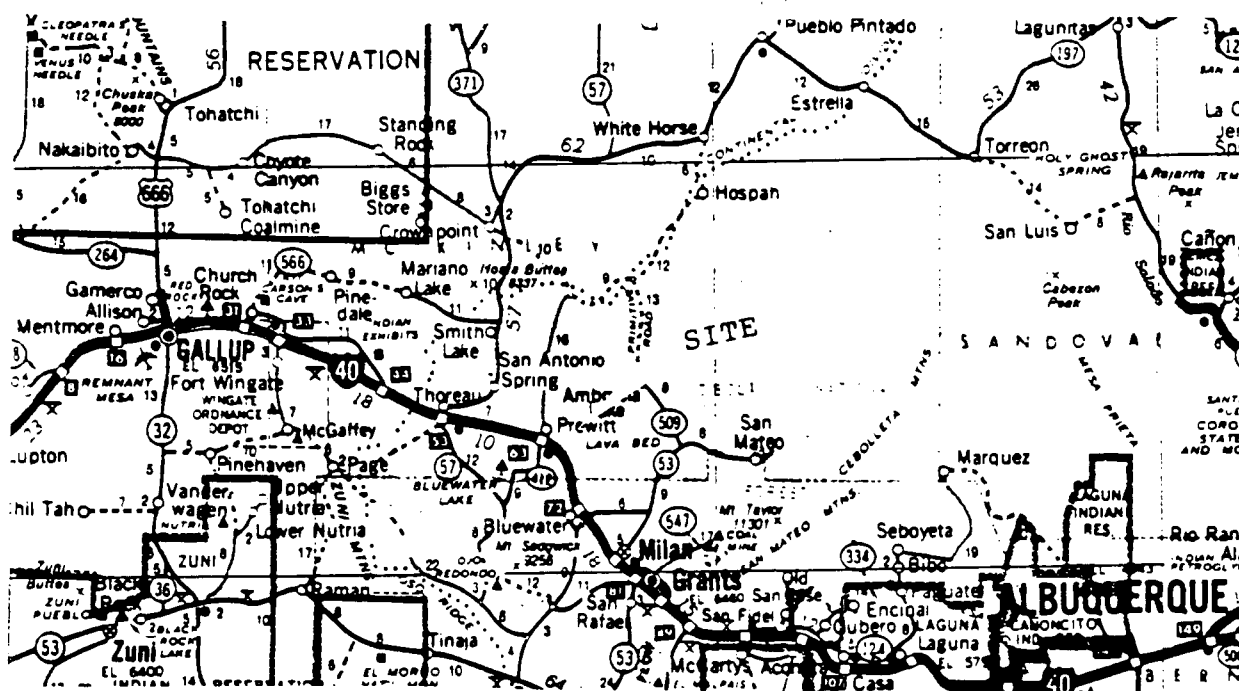
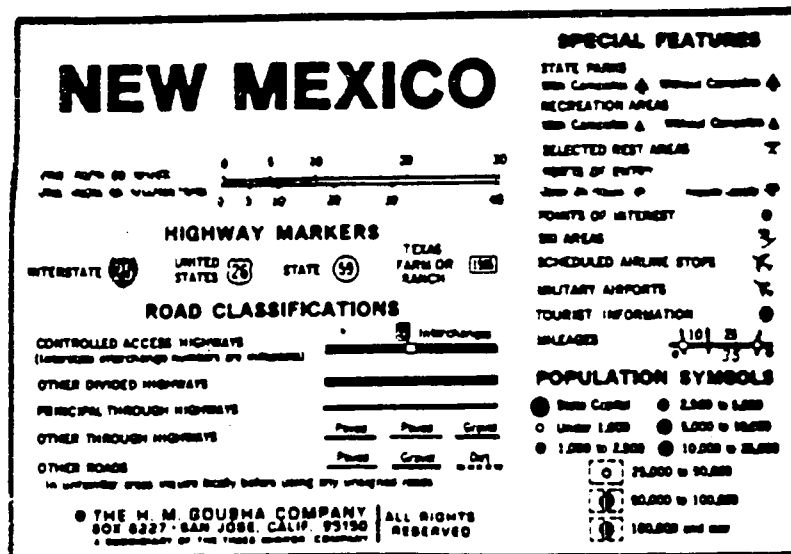


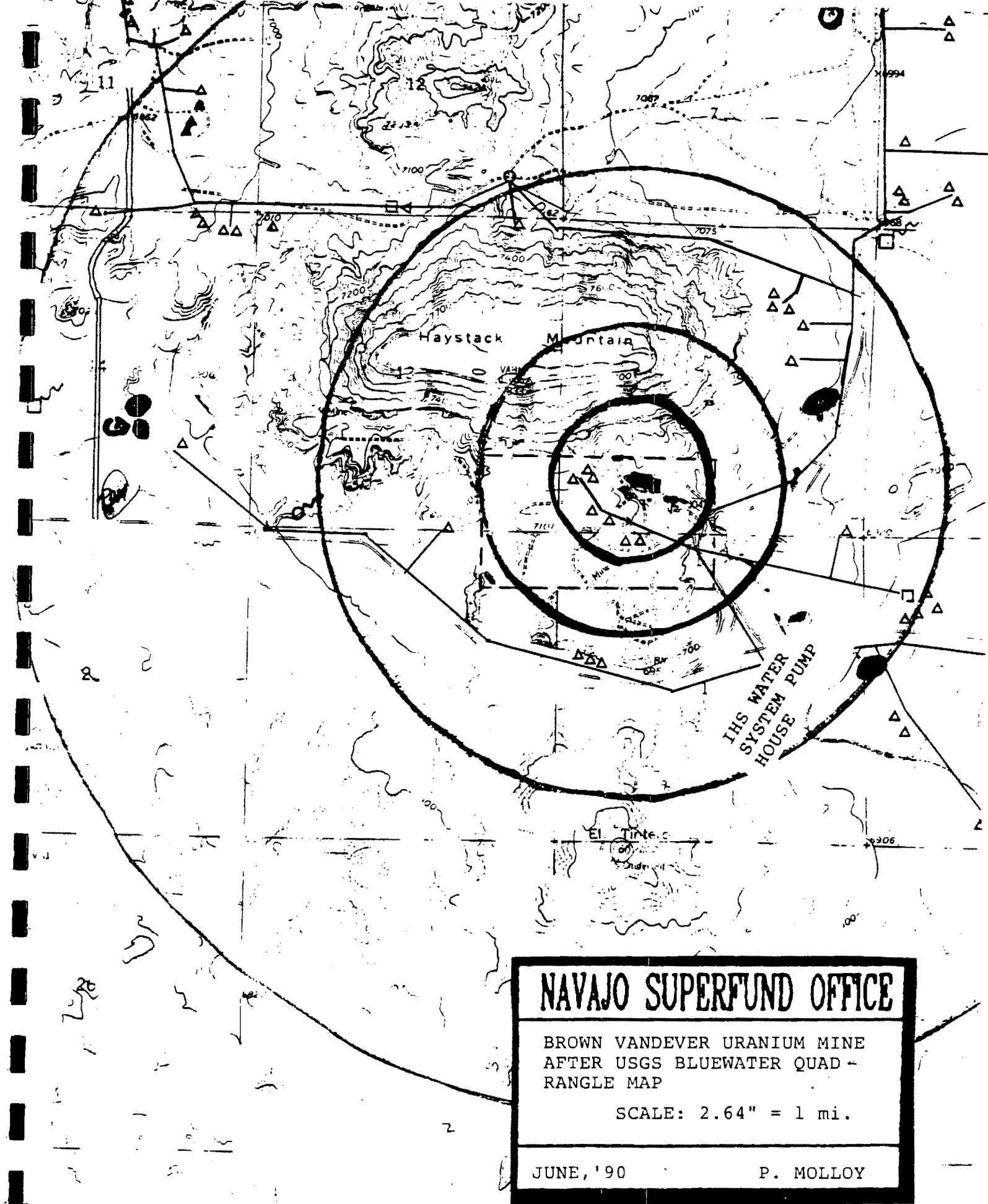
FIGURE # 1 ; REPRINTED BY PERMISSION

NAVAJO SUPERFUND OFFICE

NAVAJO-BROWN VANDEV-  
ER URANIUM MINE

JUNE, '90

P. MOLLOY



## NAVAJO SUPERFUND OFFICE

BROWN VANDEVER URANIUM MINE  
AFTER USGS BLUEWATER QUAD -  
RANGLE MAP

SCALE: 2.64" = 1 mi.

JUNE, '90

P. MOLLOY

WEN  
BLOWUP OF AREA WITHIN DASHED SQUARE

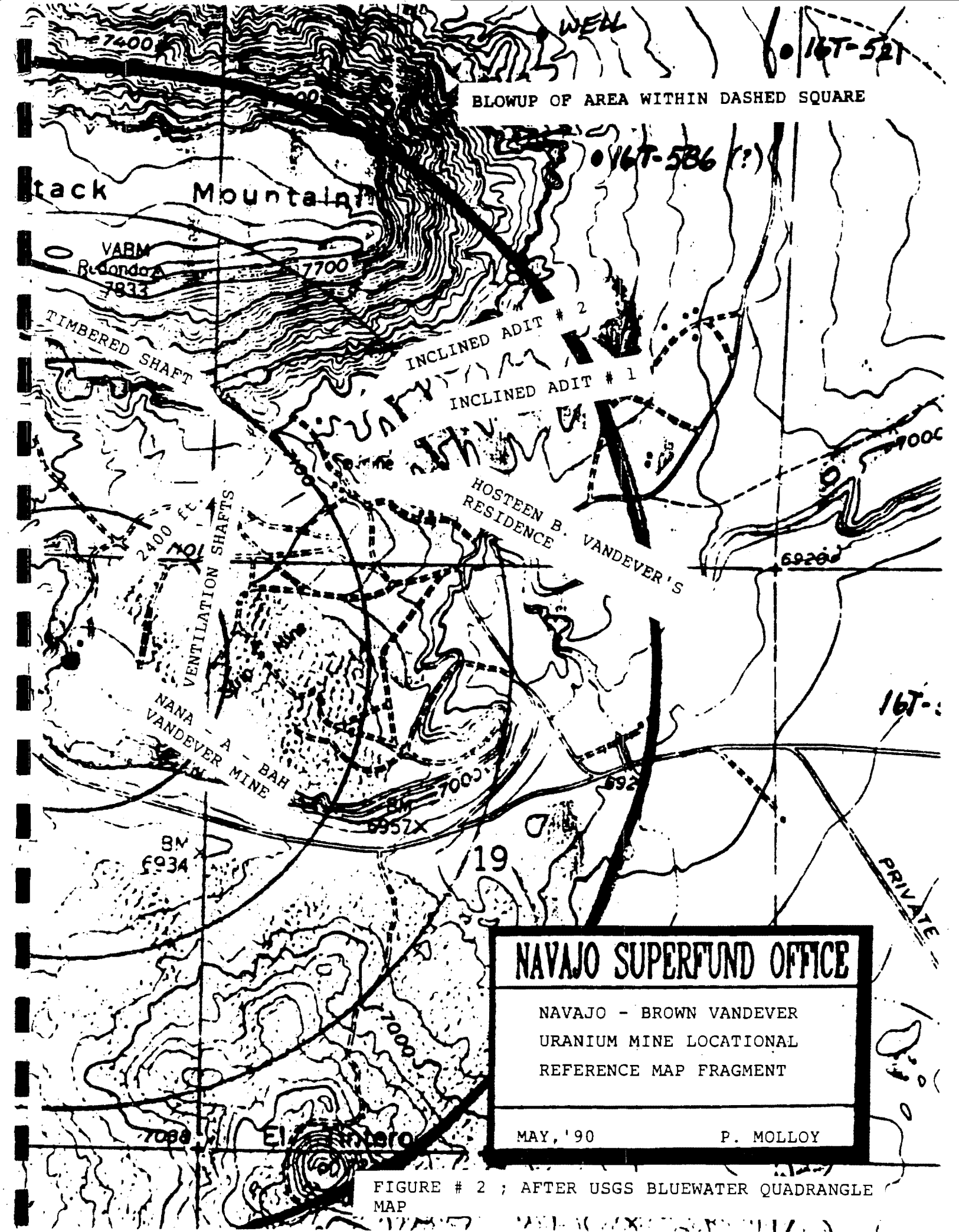
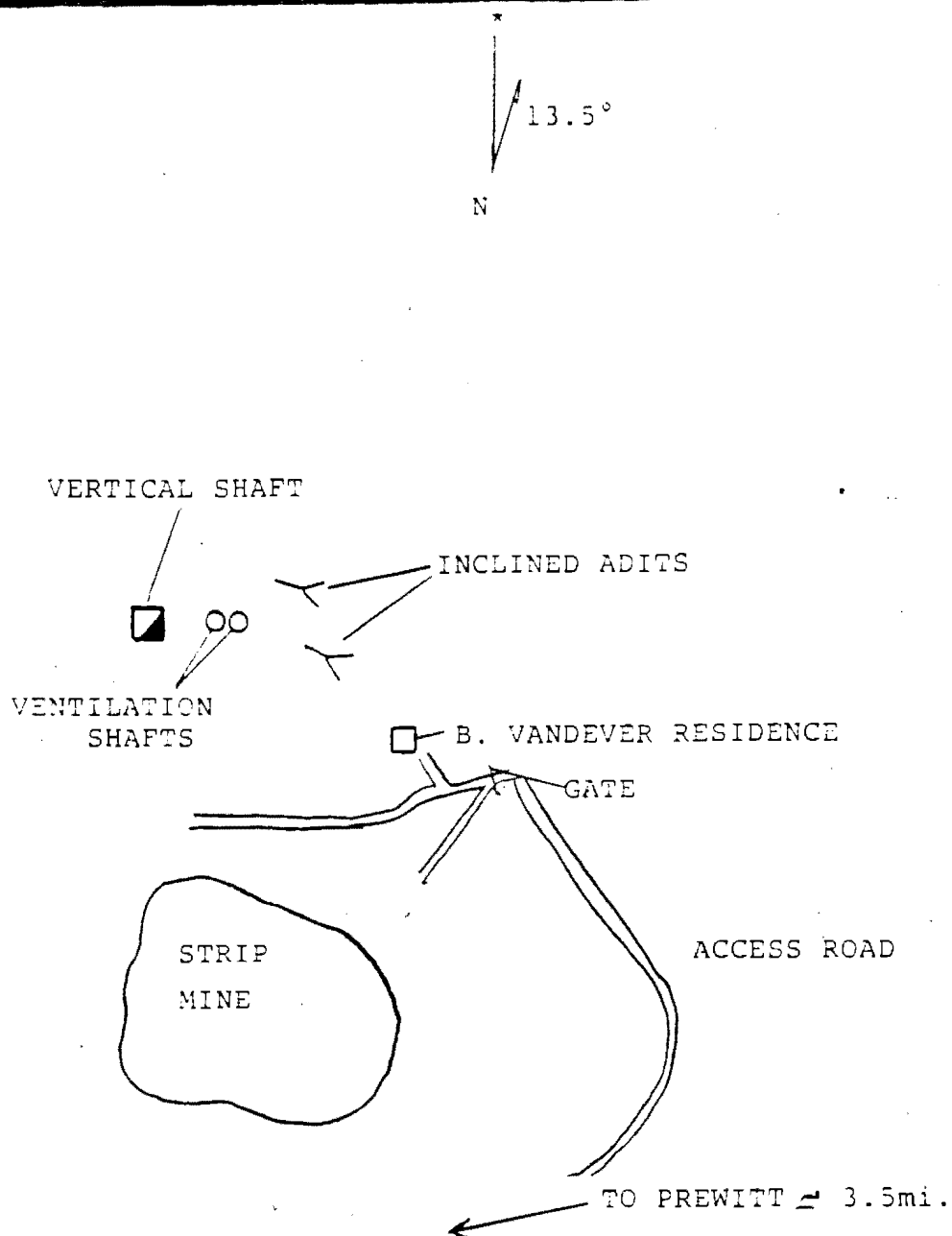


FIGURE # 2 ; AFTER USGS BLUEWATER QUADRANGLE  
MAP



SCALE - 1"  $\approx$  1418 ft.

FIGURE # 4 ; SITE SKETCH

NAVAJO SUPERFUND OFFICE

NAVAJO-BROWN VANDEV-  
ER URANIUM MINE SITE  
SKETCH

JUNE, '90 P. MOLLOY

# NAVAJO SUPERFUND DEPARTMENT

## FIT PHOTOGRAPH LOG SHEET

SITE NAME BROWN VANDEVER URANIUM MINE USEPA SITE NO. NOT ASSIGNED  
 DATE APRIL 11, 1990 TIME 10:20am WEATHER CLEAR  
 PHOTOGRAPHER P. MOLLOY ANGLE/DIRECTION 30°/ENE  
 FILM TYPE POLAROID FRAME NO. 5

DATA TAKEN WITH PHOTOGRAPH: NONE

1. Soil Sample ( )
2. Surface Water Sample ( )
3. Air Monitoring Device ( )  
 Reading: \_\_\_\_\_
4. Radiation Survey ( )  
 Reading: \_\_\_\_\_
5. Deep Well Water Sample ( )
6. Photograph Below: YES



ETH 12

7. DESCRIPTION HAYSTACK BUTTE, REFERENT, LOOKING E OF ENE

---



---



---

FIT PHOTOGRAPH LOG SHEET

SITE NAME BROWN VANDEVER URANIUM MINE USEPA SITE NO. NOT ASSIGNED  
DATE APRIL 11, 1990 TIME AFTERNOON WEATHER CLEAR  
PHOTOGRAPHER P. MOLLOY ANGLE/DIRECTION 270°/S  
FILM TYPE POLAROID FRAME NO. 20

DATA TAKEN WITH PHOTOGRAPH: \*\*\* NONE \*\*\*

1. Soil Sample ( )
2. Surface Water Sample ( )
3. Air Monitoring Device ( )  
Reading: \_\_\_\_\_
4. Radiation Survey ( )  
Reading: \_\_\_\_\_
5. Deep Well Water Sample ( )
6. Photograph Below: YES



20<sup>TH</sup> FR. (EL TINTERO  
CINDER CONE, REF. 1)

7. DESCRIPTION EL TINTERO CINDER CONE REFERENT, LOOKING  
S  
\_\_\_\_\_  
\_\_\_\_\_

FIT PHOTOGRAPH LOG SHEET

SITE NAME BROWN VANDEVER URANIUM MINE USEPA SITE NO. NOT ASSIGNED  
DATE APRIL 11, 1990 TIME 10:25am WEATHER CLEAR  
PHOTOGRAPHER P. MOLLOY ANGLE/DIRECTION 20° ENE  
FILM TYPE POLAROID FRAME NO. 7

DATA TAKEN WITH PHOTOGRAPH: YES

1. Soil Sample ( )
2. Surface Water Sample ( )
3. Air Monitoring Device ( )

Reading: \_\_\_\_\_

4. Radiation Survey ( X )

Reading: LUCLUM#19-24uR.hr<sup>-1</sup> :: ESP-II - 2.2(104)

5. Deep Well Water Sample ( ) BACKGROUND @ B VANDEVER
6. Photograph Below: YES



T<sup>H</sup> F.R.

7. DESCRIPTION TRENCH CUT NNE OF B. VANDEVER RESIDENCE  
LOOKING NE. NOTE FRAMES 8, 9, 10 TAKEN AT SAME LO-  
CATION

FIT PHOTOGRAPH LOG SHEET

SITE NAME BROWN VANDEVER URANIUM MINE USEPA SITE NO. NOT ASSIGNED  
DATE APRIL 11, 1990 TIME 10:25am WEATHER CLEAR  
PHOTOGRAPHER P. MOLLOY ANGLE/DIRECTION 10° N OF NNE  
FILM TYPE POLAROID FRAME NO. 15

DATA TAKEN WITH PHOTOGRAPH: YES

1. Soil Sample ( )
2. Surface Water Sample ( )
3. Air Monitoring Device ( )

Reading: \_\_\_\_\_

4. Radiation Survey ( X )

Reading: 350uR/hr-1 (LUDLUM#19) : @ EDGE OF "LOADING BAY"

5. Deep Well Water Sample ( )
6. Photograph Below: YES



15<sup>th</sup> FR.

7. DESCRIPTION TRENCH AT CENTER MIDDLEGROUND IS CRE  
"LOADING BAY", LOOKING N OF NNE  
\_\_\_\_\_  
\_\_\_\_\_

levels, the following observations were made;

- \* The population distribution is closely correlated with the Indian Health Service (IHS) water system (tautological).
- \* Several windmills in the area are no longer in service. At least one windmill shows infrequent use (18; pg #1).
- \* There are 7 residences on site: not all these residences are connected to the IHS water system.
- \* The old haulage road (for ore transport) is plainly visible and shows definite erosion: The road that obtains access to the site was at one time the haulage road. There is radiometric evidence that contaminants are migrating off site (18, pg #2).
- \* A drainage which trends east from the site exhibits radiometric readings consistent with contaminant transport/migration.
- \* The onsite haulage road was "paved" with mine tailings and provides a receptacle for mechanical transport of contaminants. An Eberline Gamma Ratemeter registered  $10^3$  cpm at the edge of the road (3; frame #22, 14; page #4) There is radiometric evidence of mechanical (eg, vehicle) transport of contaminants approximately 2 mi. from the site environs via the haulage road (18; page #2)
- \* The timbered shaft retains a shack at its mouth, however, access to the shaft can easily be gained by removing a wire grate covering the portal (3; Frame #33). Additionally, the shaft "aspirates" under certain meteorological conditions, contributing to the area Radon burden.
- \* The vertical ventilation shafts are poorly capped and young children in the area could easily gain access to the excavations (3; Frame #33).
- \* One inclined adit is used for waste disposal (3; Frame #12).
- \* Small quantities of ore grade material are to be found almost anywhere on site.
- \* Approximately 1880 tons of tailings materials are presently onsite. The material is uncovered and accessible (3.; Frames #8, #13, #15, #19, Frames #25 through #32).
- \* The Navajo Superfund Office FIT digilert alerted (enabled) inside the vehicle being used for reconnaissance at one point along the "Hot Road" (3; Frame #22): enable/alert on the device is set at .098 mR.hr-1.

Tailings material, the inclined adits and the timbered shaft are suspected of producing a leachate rich in toxic heavy metals and radioactive contaminants (4,11,23). Radiometric readings taken during

# NAVAJO SUPERFUND DEPARTMENT

## FIT PHOTOGRAPH LOG SHEET

SITE NAME BROWN VANDEVER URANIUM MINE USEPA SITE NO. NOT ASSIGNED  
 DATE APRIL 11, 1990 TIME 11:15am WEATHER CLEAR TO SLIGHTLY OVERCAST  
 PHOTOGRAPHER P. MOLLOY ANGLE/DIRECTION 180°/W  
 FILM TYPE POLAROID FRAME NO. 16

DATA TAKEN WITH PHOTOGRAPH: YES

1. Soil Sample ( )
2. Surface Water Sample ( )
3. Air Monitoring Device ( )

Reading: \_\_\_\_\_

4. Radiation Survey (X)

Reading: SEE BELOW IN DESCRIPTION

5. Deep Well Water Sample ( )
6. Photograph Below: YES , EXTRA FRAME



16<sup>TH</sup> FR.  
 MOUTH OF DRAINAGE

7. DESCRIPTION MOUTH OF DRAINAGE, TAILINGS PILE ON RIGHT,  
ESP-II READINGS: 1MOUTH - 5(10<sup>4</sup>); 2MIDWAY PAST TAILING  
- 6.5(10<sup>4</sup>); 3END OF TAILINGS - 3.25(10<sup>4</sup>); ALL READINGS  
IN cpm., LOOKING W

FIT PHOTOGRAPH LOG SHEET

SITE NAME BROWN VANDEVER URANIUM MINE USEPA SITE NO. NOT ASSIGNED  
DATE APRIL 11, 1990 TIME AFTERNOON WEATHER CLEAR  
PHOTOGRAPHER P. MOLLOY ANGLE/DIRECTION 0° E  
FILM TYPE POLAROID FRAME NO. 22

DATA TAKEN WITH PHOTOGRAPH: YES

1. Soil Sample ( )
2. Surface Water Sample ( )
3. Air Monitoring Device ( )

Reading: \_\_\_\_\_

4. Radiation Survey (X)

Reading: 105cpm (ESP-11) @ EDGE OF ROAD

5. Deep Well Water Sample ( )
6. Photograph Below: YES



22-11-90

7. DESCRIPTION "HOT ROAD" WEST OF B. V. RESIDENCES, SUR-  
FACE WORKS WASTE PILES @ RIGHT MIDDLEGROUND, MT. TAY-  
LOR @ UPPER LEFT BACKGROUND AS REFERENT

# NAVAJO SUPERFUND DEPARTMENT

## FIT PHOTOGRAPH LOG SHEET

SITE NAME BROWN VANDEVER URANIUM MINE USEPA SITE NO. NOT ASSIGNED  
 DATE APRIL 11, 1990 TIME AFTERNOON WEATHER CLEAR TO SLIGHTLY OVERCAST  
 PHOTOGRAPHER P. MOLLOY ANGLE/DIRECTION 135° NW  
 FILM TYPE POLAROID FRAME NO. 33

DATA TAKEN WITH PHOTOGRAPH: YES

1. Soil Sample ( )
2. Surface Water Sample ( )
3. Air Monitoring Device ( )

Reading: \_\_\_\_\_

4. Radiation Survey (X)

Reading: 10uR.hr<sup>-1</sup> (LUDLUM#19), 10<sup>4</sup>cpm(ESP-II) @ WEST  
FACE OF SHACK

5. Deep Well Water Sample ( )
6. Photograph Below: YES



332 ER.

7. DESCRIPTION B. VANDEVER TIMBERED SHAFT, SHAFT AT AN IN-  
CLINATION OF 10° FROM VERTICAL, CIRCULAR APERTURE  
ON S FACING WALL IS WIRED OVER BUT WIRE IS EASILY  
REMOVED, SHAFT ASPIRATES, "300 FT. DEEP" B. V. TO

P. MOLLOY, APRIL 11, 1990

P.M.

# NAVAJO SUPERFUND DEPARTMENT

## FIT PHOTOGRAPH LOG SHEET

SITE NAME BROWN VANDEVER URANIUM MINE USEPA SITE NO. NOT ASSIGNED  
 DATE APRIL 11, 1990 TIME AFTERNOON WEATHER CLEAR TO SLIGHTLY OVERCAST  
 PHOTOGRAPHER P. MOLLOY ANGLE/DIRECTION 250° WNW  
 FILM TYPE POLAROID FRAME NO. 33

DATA TAKEN WITH PHOTOGRAPH: \*\*\* NONE \*\*\*

1. Soil Sample ( )
2. Surface Water Sample ( )
3. Air Monitoring Device ( )  
 Reading: \_\_\_\_\_
4. Radiation Survey (X )  
 Reading: \_\_\_\_\_
5. Deep Well Water Sample ( )
6. Photograph Below: YES



33<sup>rd</sup> FR.  
 (VENT. SHA. VERTICAL !)

7. DESCRIPTION VERTICAL VENTILATION SHAFTS(2), HOSTEEN  
BROWN VANDEVER AT RIGHT MIDDLEGROUND, SHAFTS "300  
FT. DEEP" - B. V. TO P. MOLLOY, APRIL 11, 1990, LOOK-  
WNW

PCMA

NAVASC SUPERFUND SITE  
FIT PHOTOGRAPH LOG SHEET

SITE NAME BROWN VANDEVER URANIUM MINE USEPA SITE NO. NOT ASSIGNED  
DATE APRIL 11, 1990 TIME 10:25am WEATHER CLEAR  
PHOTOGRAPHER P. MOLLOY ANGLE/DIRECTION 100°/NNW  
FILM TYPE POLAROID FRAME NO. 12

DATA TAKEN WITH PHOTOGRAPH: YES

1. Soil Sample ( )
2. Surface Water Sample ( )
3. Air Monitoring Device ( )

Reading: \_\_\_\_\_

4. Radiation Survey (X)

Reading: LUDELUM-19 - 21uR.hr<sup>-1</sup> : @ FACE OF ADIT

5. Deep Well Water Sample ( )
6. Photograph Below: YES



2-1-90

7. DESCRIPTION INCLINED ADIT N OF B. VANDEVER RESIDENCE  
LOOKING NNW

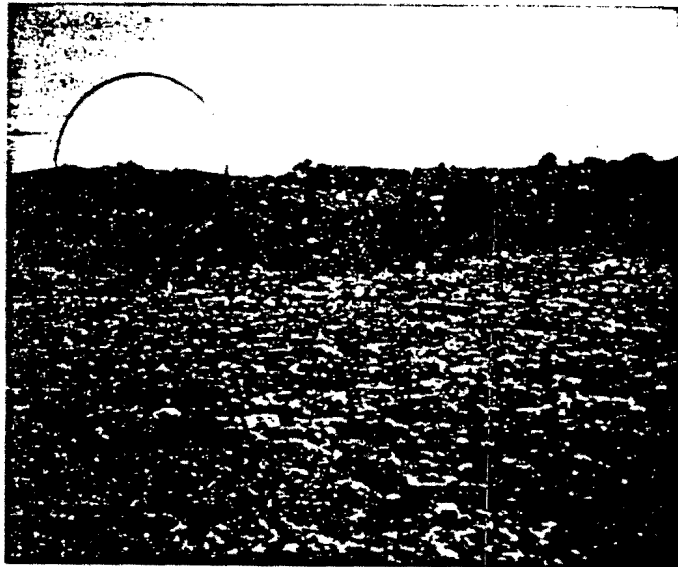
# NAVAJO SUPERFUND DEPARTMENT

## FIT PHOTOGRAPH LOG SHEET

SITE NAME BROWN VANDEVER URANIUM MINE USEPA SITE NO. NOT ASSIGNED  
 DATE APRIL 11, 1990 TIME AFTERNOON WEATHER CLEAR  
 PHOTOGRAPHER P. MOLLOY ANGLE/DIRECTION 350° E OF ES  
 FILM TYPE POLAROID FRAME NO. 26

DATA TAKEN WITH PHOTOGRAPH: \*\*\* NONE \*\*\*

1. Soil Sample ( )
2. Surface Water Sample ( )
3. Air Monitoring Device ( )  
 Reading: \_\_\_\_\_
4. Radiation Survey ( X )  
 Reading: \_\_\_\_\_
5. Deep Well Water Sample ( )
6. Photograph Below: YES



26<sup>TH</sup> FR

7. DESCRIPTION SURFACE WORKS WSW OF B. V. RES., LOOKING  
E OF ESE; NOTE MT. TAYLOR IN FAR LEFT BACKGROUND.  
AS REFERENT

FIT PHOTOGRAPH LOG SHEET

SITE NAME BROWN VANDEVER URANIUM MINE USEPA SITE NO. NOT ASSIGNED  
DATE APRIL 11, 1990 TIME \_\_\_\_\_ WEATHER CLEAR  
PHOTOGRAPHER P. MOLLOY ANGLE/DIRECTION \_\_\_\_\_  
FILM TYPE POLAROID FRAME NO. 28

DATA TAKEN WITH PHOTOGRAPH: \*\*\* NONE \*\*\*

- 1. Soil Sample ( )
- 2. Surface Water Sample ( )
- 3. Air Monitoring Device ( )

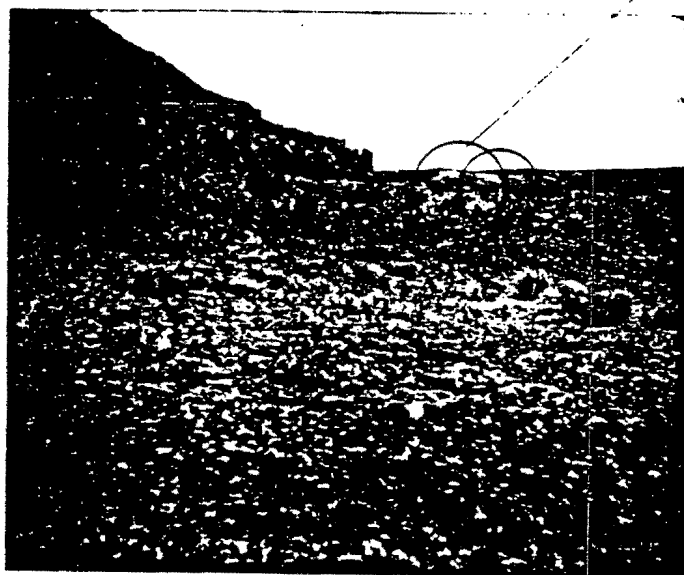
Reading: \_\_\_\_\_

- 4. Radiation Survey (X)

Reading: \_\_\_\_\_

- 5. Deep Well Water Sample ( )

- 6. Photograph Below: YES, SEE SKETCH



28 = EN

7. DESCRIPTION SEE SKETCH  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

# NAVAJO SUPERFUND DEPARTMENT

## FIT PHOTOGRAPH LOG SHEET

SITE NAME BROWN VANDEVER URANIUM MINE USEPA SITE NO. NOT ASSIGNED  
 DATE APRIL 11, 1990 TIME 11:15am WEATHER CLEAR TO SLIGHTLY OVERCAST  
 PHOTOGRAPHER P. MOLLOY ANGLE/DIRECTION SEE SKETCH  
 FILM TYPE POLAROID FRAME NO. 31

### DATA TAKEN WITH PHOTOGRAPH:

1. Soil Sample ( )
2. Surface Water Sample ( )
3. Air Monitoring Device ( )  
 Reading: \_\_\_\_\_
4. Radiation Survey ( X )  
 Reading: \_\_\_\_\_
5. Deep Well Water Sample ( )
6. Photograph Below: YES



SKETCH

7. DESCRIPTION \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

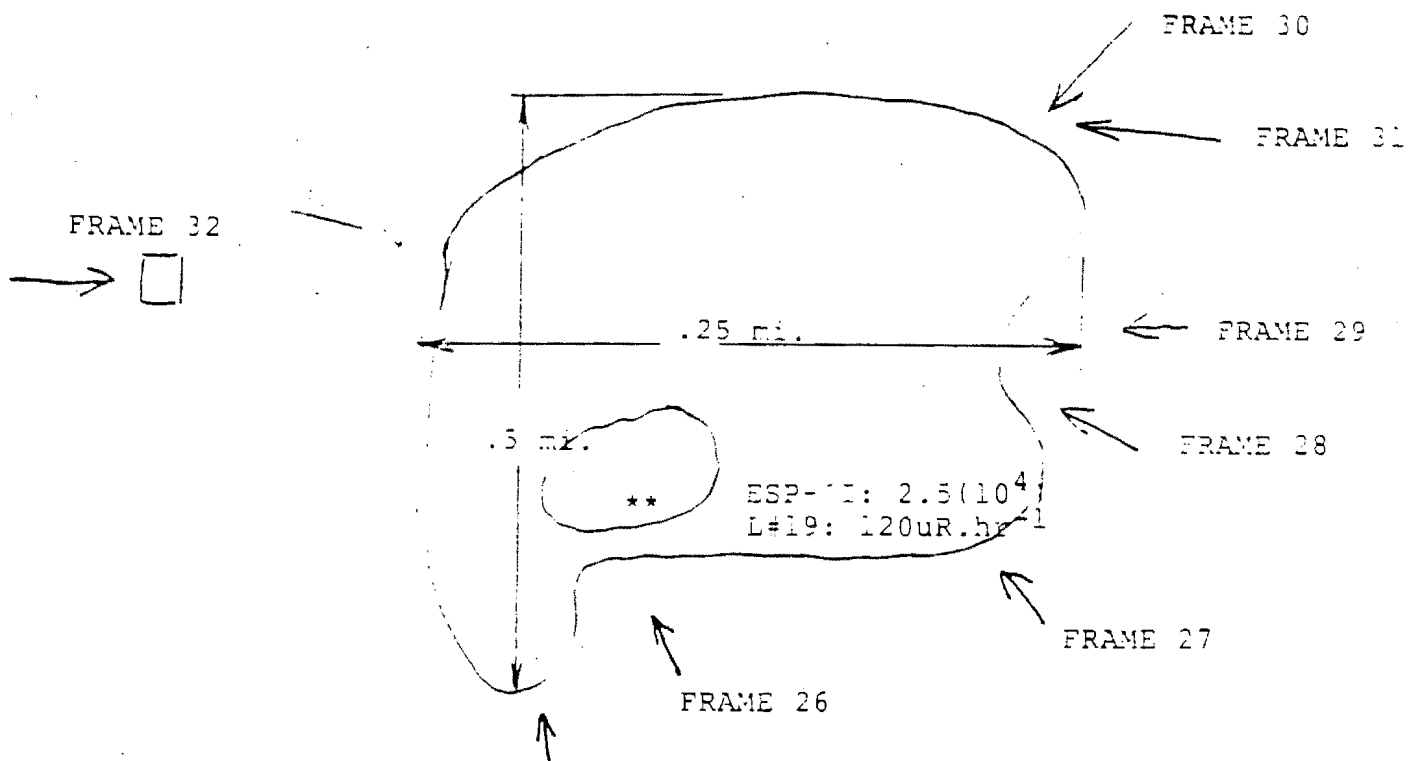
# NAVAJO SUPERFUND DEPARTMENT

## 711 PHOTOGRAPH LOG SHEET

SITE NAME BROWN VANDEVER URANIUM MINE USEPA SITE NO. NOT ASSIGNED  
 DATE APRIL 11, 1990 TIME 11:15am WEATHER CLEAR TO SLIGHTLY OVERCAST  
 PHOTOGRAPHER P. MOLLOY ANGLE/DIRECTION -  
 FILM TYPE POLAROID FRAME NO. NO FRAME

DATA TAKEN WITH PHOTOGRAPH: SKETCH

1. Soil Sample ( )
2. Surface Water Sample ( )
3. Air Monitoring Device ( )  
 Reading: \_\_\_\_\_
4. Radiation Survey ( X )  
 Reading: SEE BELOW
5. Deep Well Water Sample ( )
6. Photograph Below: \*\*\* NONE \*\*\*



FRAME 25 \* RADIOMETRIC READINGS ASSOCIATED  
 WITH FRAME 27  
 7. DESCRIPTION SKETCH OF AREA WHERE RADIOMETRIC READINGS  
WERE TAKEN, NO SCALE

a windshield survey indicate that a substantial fraction of  $\frac{1}{4}$  of a section (160 acres) is contaminated with mine tailings. Tailings piles, the incined adits and the timbered shaft are unfenced and readily accesible to site residents (3). There is no documentation of emergencies, accidents or remedial action regarding the Brown Vandever Uranium mine site.

### 3. WASTE CONTAINMENT/HAZARDOUS SUBSTANCE

An estimated total of 532,000 tons of mining waste is present in the two major tailings piles on site (4). Computations indicate that there are approximately 1880 tons of toxic compounds and elements dessiminated within the 532,000 tons of rubble at the site (3; Frames #8, #13, #15, #19, #25 through #32, 4). These contaminants are exposed and uncontained and are therefore capable of producing leachate subject to migration into atmospheric, ground water and surface water systems (11, 22, 23, 24, 25). The exposed inclined adits, timbered shaft and stopes may also be producing a leachate similar in composition to that produced by the tailings piles.

Specific radioactive species contributing to contamination of the leachate are uranium ( $U^{235}$ ,  $U^{238}$ ), and its daughter products  $Ra^{226}$ ,  $Th$ , isotopes of  $Pb$ ,  $Bi^{214}$ , etc). The enclosed portions of the adits and shaft may contain significant concentrations of Radon gas. Toxic heavy metal species suspected of being present in the mining waste in significant concentrations are Vanadium, Arsenic, Barium, Chromium, Magnesium, Manganese, Strontium, Titanium and Zirconium. Table 1 provides a summary of hazardous substances potentially present in the waste piles and in the open excavations.

### 4. PATHWAY CHARACTERISTICS

#### A. AIR CHARACTERISTICS

The potential for mobility of hazardous and toxic compounds associated with  $U_3O_8$  and  $V_2O_5$  mining waste is high due to the particulate nature of the waste and the occasional high winds native to the area which may cause migration of windblown contaminants offsite.

#### B. GROUNDWATER CHARACTERISTICS

Regionally, the site is bounded on the north by the central San Juan Basin and on the south by the Zuni uplift. Structural elements of the Acoma Sag lie southeast of the site (5;pgs 16,18:6). The geological element where the site is located is termed the Chaco slope (5;pg 16).

"Kelley (1951, p. 126) describes the Chaco slope as the southern part of the San Juan Basin that lies between the central Basin (fig. 2.5 -1) and the Zuni uplift and Acoma Sag. The Chaco slope resembles the platforms but differs from them because of "Its more pronounced and continous regional inclination toward the center of the basin and by the absence of a 'Monocline' separating it from the central basin " (Kelley, 1951, p.126).

Jurassic rocks from the Morrison formation and Chinle formation (which

TABLE 1. Quantity of Undisseminated Toxic  
Compounds and Elements Within Tailings  
Piles at Brown Vandever Uranium Mine

	Waste	Quantity of Undisseminated Hazardous Waste*	Disposal Location	Origination
1.	U <sub>3</sub> O <sub>8</sub>	6.35 (10 <sup>6</sup> ) kg	On-Site	Low Grade Uranium/ Vanadium
2.	V <sub>2</sub> O <sub>5</sub>	1.04 (10 <sup>6</sup> ) kg	On-Site	" "
3.	Radium	Unknown	"	" "
4.	Thorium	"	"	" "
5.	Arsenic	"	"	" "
6.	Selenium	"	"	" "
7.	Radon	"	"	" "
	TOTAL	1880 tons		

\* CUSTOMARY UNITS FOR REPORTING ABUNDANCES  
OF RADIONUCLIDES ARE MASS UNITS.

locally includes the Moenkopi formation) dip westwardly into the adjacent Chaco slope (3; frame# 20 and enlargement: 6:8). A Cretaceous sequence is present adjacent to the site on Haystack mountain and is represented by the Dakota sandstone exposure (3: frame #20 and enlargement). Triassic units represented by the Moenkopi and Chinle formations dip eastwardly into the adjacent Chaco slope (3; frame #20 and enlargement Figure #3).

Quaternary Alluvium (Pleistocene) has accumulated in variable thicknesses in streambeds in the area (32).

The Aquifer of concern in the Vicinity of the site is the Sonsela Sandstone member of the Chinle formation which sources the Navajo Nation Water Resources Division (NNWRD) well #16T-551 (19). Depth to water in this well is documented and is reported to be 417 feet (circa 1976). Depth to the Sonsela sandstone member of the Chinle formation is 1083 feet. The only other Aquifer known to source wells in the area is the Entrada Sandstone (19). The net precipitation for the locale is estimated to be minus 44 inches (5, 12).

Contaminants of concern present in the tailings piles are the radionuclides  $^{238}\text{U}$ ,  $^{235}\text{U}$  and their progeny  $^{232}\text{Th}$ ,  $^{214}\text{Bi}$ ,  $^{214}\text{Po}$ , isotopes of Pb and Radon gas. Toxic heavy metal species suspected of being present in the mining waste in significant concentrations are Ar, Ba, Mg, Mn, Sr, Ti and Zr. (11, table 1). Many of these species have been demonstrated by various authors to be mobile in waters associated with Uranium mines (23,24,25,26,27,28 and 29). The Hydraulic conductivity of the formations between the Alluvium and the Sonsela sandstone member is estimated to be of the order of  $10^{-3}$  because of fractures and faults. This is consistent with the close proximity of the El Tintero Cinder Cone and the epochal geological development of the area. In addition, at least three excavations are driven to within 100 feet of the static water level in NNWRD well #16T-551. It follows that the possibility exists for these Radioactive and toxic heavy metal species to have migrated into the alluvial and Sonsela sandstone Aquifers which source an Artesian spring and NNWRD well #16T-551, respectively (3; frame #35: 19). Water depth in the alluvial Aquifer is not known but is expected to be shallow (5; pg. #40, fig.#4.3-1)

#### C. SURFACE WATER CHARACTERISTICS

A portion of the Brown Vandever mine site is located on a southeastwardly dipping Alluvial plate (3; frame #8) whose upgradient drainage area is estimated to be approximately 59.1 acres (4; worksheet #1). The stripmine portion of the site is located on a northwardly dipping Alluvial plate whose upgradient drainage area is estimated to be 14.23 acres (4; worksheet #1). Surface runoff from the 59.1 acre portion proceeds overland and along minor drainages eastwardly (3; frame #16') until encountering a well-defined drainage which trends southeastwardly, (3; frame #17, #18). Surface runoff from the 14.23 acre portion proceeds overland and along minor drainages eastnortheastwardly (3; frame #31) until encountering the well-defined drainage which trends southeastwardly (7). The drainage proceeds southeastwardly for approximately 4 mi. before becoming evanescent (7, 31). Data from a gauging station on the Rio San Jose at Grants, New Mexico indicates an

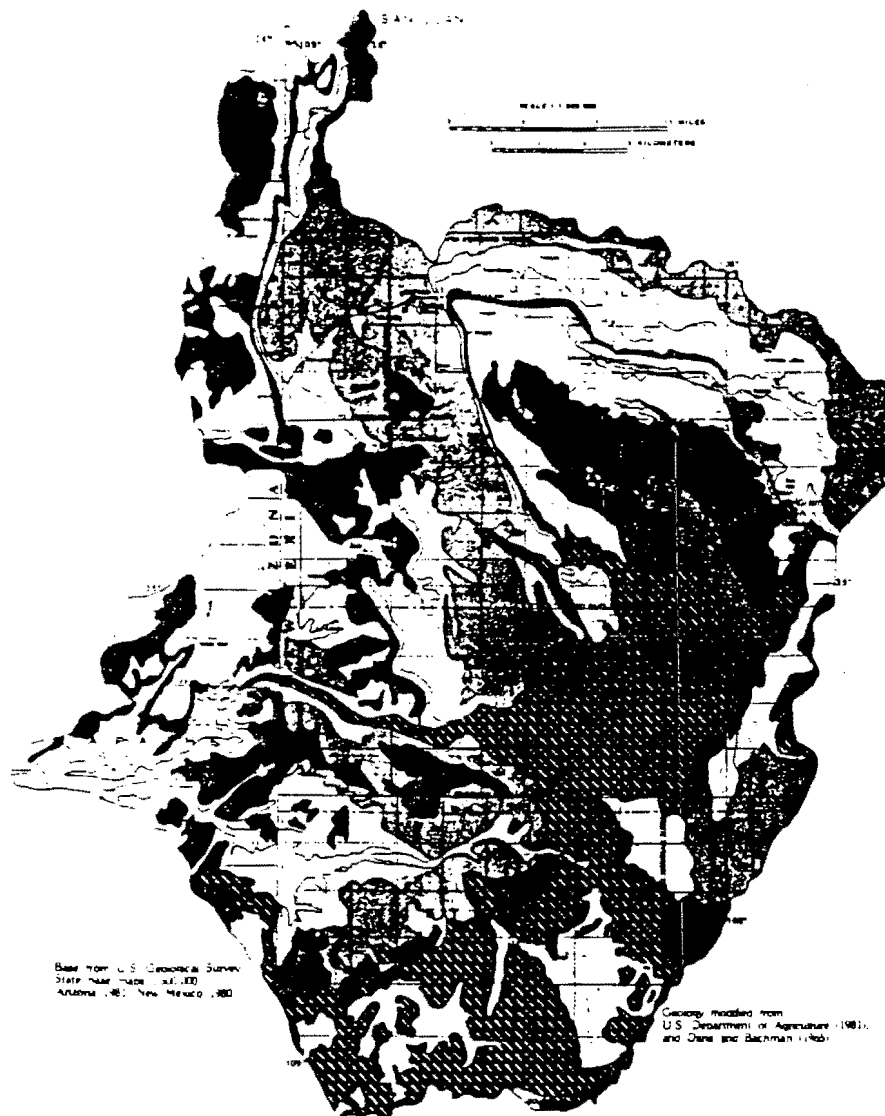


Figure 2-1 Generalized geologic map.

EXPLANATION

QUATERNARY AND TERTIARY	ALLUVIUM AND BOLSON DEPOSITS
	IGNEOUS ROCKS, INCLUDES BASALT FLOWS, VOLCANIC BRECCIA, TUFF AND CINDERS, AND EXPOSED INTENSIVE IGNEOUS ROCKS
TERTIARY	SEDIMENTARY ROCKS INCLUDING BIDAMOCKI FORMATION, CHUSA SANDSTONE, AND SACA FORMATION
CRETACEOUS	MESAVERDE GROUP
	MANCOS SHALE AND DAKOTA SANDSTONE, UNDIVIDED
JURASSIC	MORRISON FORMATION, LUNI SANDSTONE, AND SAN RAFAEL GROUP, UNDIVIDED
JURASSIC AND TRIASSIC	CLAY CANYON GROUP
TRIASSIC	CHINLE FORMATION, LOCALLY INCLUDES MOWDEEN FORMATION
PERMIAN	SAN ANDRES LIMESTONE AND GLORIETA SANDSTONE IN NEW MEXICO, DE CHILEY SANDSTONE IN ARIZONA, AND THE YESO AND ABO FORMATIONS IN NEW MEXICO
PERMIAN AND PENNSYLVANIAN	SUPAI FORMATION
PRECAMBRIAN	PRECAMBRIAN ROCKS, UNDIVIDED

FIGURE = 2 ; REGIONAL GEOLOGY,  
AFTER USGS, HYDROLOGY OF REGION 62

NAVAJO SUPERFUND OFFICE

NAVAJO-BROWN VANDEV-  
ER URANIUM MINE

JUNE, '90

P. MOLLOY

annual discharge rate of 2.97 cfs (20). The regional 1-yr, 24-hr rainfall event for the locale is 1.26 inches (13). Radioactive and toxic heavy metal species have been shown to be mobile in surface waters (23 through 29). In particular, Arsenic and Selenium are known to sorb strongly to surface water sediments (26,28). The possibility exists for contaminated sediments to have been carried by flash floods, over the decades, onto the Alluvial plain east of El Tintero cinder cone (figure #2,7). A slight possibility exists for contaminated sediments to have been carried into Bluewater creek and the Rio San Jose (5,7). The area has not been mapped in a flood plain, However, due to the arid nature of the upgradient terrain and the general topography, the locale is prone to flash flooding events. Moreover, Haystack Mountain is very likely to be a recharge zone for aquifers in the area (5;pg#38).

#### D. ON SITE PATHWAY

As with other mines in the area the proto-ore was abandoned on-site. In the case of the Brown Vandever Mine, some of it was used to pave a haulage road which is used by site residents frequently (3;frame#22). The Brown Vandever mine environs are readily accessible by site residents and visitors to the area (3). There are no access barriers or danger signs on or near the mine site (3). Direct contact with contaminated particulates is possible during periods of high winds or physical disturbance of the tailings material. Humans living on-site and visitors to the area would be at risk to exposure from the same suite of radionuclides and heavy metals detailed above. Moreover, the ventilation shafts, the almost vertical timbered shaft and the inclined adits pose physical danger immediately dangerous to life and health status.

#### 5. TARGETS

GROUND WATER TARGETS. There are three active wells within the 4 mile radius of influence of the site (19,21). The Indian Health Service (IHS) completed installation of a community Water System in October 1986 (21). Subsequent to the completion of the water system, operation and maintenance of the system was turned over to the Navajo Nation and is currently under the purview of NNWRD (19). The community water system utilizes well #16T-551 which was formerly a livestock water well. The water system serves approximately 430 persons in the Haystack area (4;worksheet #2). Total population within the four mile radius of influence of the site was estimated to be approximately 500 (4;worksheet#2): The percentage of area residents not connected to the NNWRD water system was estimated to be 23% (=100 persons) on the basis of a residence count and the fact that 43.8% of Indian homes had their source of water more than 100 yds from their residence (3,18,31). Area residents too indigent to afford plumbing and sewerage systems for their residences might utilize water from the active NNWRD stockwells #16T-522 and # 16T-521 (19,3;frame#41,18;pg.#1). In addition, there is at least 1 artesian spring in the immediate vicinity of the site (7;Bluewater Quad, 3;frame #35). There is a slight possibility that this spring could be utilized for drinking water.

The Aquifer of concern in the area is the Entrada sandstone unit which

sources windmills possibly utilized for potable water by as many as 100 persons (4;worksheet#2,18;pg.#1,3;frame#41). Depth to the water table in this confined unit is reported to be approximately 400 feet (19). As pointed out before, the shaft and inclines have been driven to within 100 feet of this aquifer. Targets in the area consuming groundwater from the Entrada sandstone unit are at risk to exposure from Radionucleides and heavy metals (II).

**SURFACE WATER TARGETS** Surface water targets would be potentially exposed to the same suite of Radionucleides and heavy metals that is the case with ground water targets. Risk of exposure may be low due to the low value for net precipitation for the area. However, extreme conditions brought in the area would inundate the highly eroded haulage road (18).

The well-defined drainage coursing first east and then southeast from the site crosses at least one federally designated wetland (9).

**AIR TARGETS** Humans living on site are being exposed to elevated Radon concentrations.

**ON-SITE TARGETS** In addition to being exposed to elevated Radon concentrations, residents of the Brown Vandever mine environs are confronted daily with the dangerous inclines, shafts and the insult to their land.

**SENSITIVE ENVIRONMENTS** At least one federally designated sensitive environment lies within 1 mile of the site.

## 6. OTHER REGULATORY INVOLVEMENT

**PERMITS:** No permit was found for the Brown Vandever Uranium mine

**STATE AGENCIES:** None

**OTHER FEDERAL PROGRAMS:** None

## 7. CONCLUSIONS AND RECOMMENDATIONS

The Brown Vandever Uranium mine site is exceptionally dangerous. However, no steps toward remediation or mitigation have been undertaken over the two and one half decades since cessation of activities. To assert that residents of the site have not been adversely affected by the insult to their land and very possibly their health is inadmissible.

Immediate action should be taken.

## Reference List

### Reference No.

1. Molloy, P., February 16, 1990. EPA Potential Hazardous Waste Site Identification for Brown side Uranium Mine, Bluewater, NM
2. New Mexico Bureau of Mines, 1983. Open file report OFR - 183. Uranium and Thorium occurrences in New Mexico: Distribution, Geology, Production and Resources.
3. Molloy P., April, 1990. Population, Population distribution, water usage and radiation survey for Haystack community.
4. Molloy, P., May, 1990. Mine Spoils calculations for the Brown Vandever Uranium Mine; worksheet for upgradient drainage area calculation; worksheet for population estimate.
5. United States Geological survey (USGS), April, 1984. Hydrology of area 62, Northern Great Plains and Rocky Mountain Coal Provinces, Colorado and New Mexico (open-file Report 83-698). Excerpts.
6. New Mexico Bureau of Mines and Mineral Resources, 1974. Geologic Map of Grants Uranium Region.
7. USGS 7.5 Minutes Topographic Maps: Bluewater Quadrangle, 1957; Ambrosia Lake Quadrangle, 1957; Goat Mountain Quadrangle, 1957; Prewitt Quadrangle, 1963; Thoreau NE Quadrangle, 1963; Dos Lomas Quadrangle, 1957.
8. New Mexico Geological Society, 1977. Guidebook of San Juan Basin III: Stratigraphic nomenclature chart and Haystack environs field notes (Excerpts).
9. US Fish and Wildlife, 1984. National Wetlands Inventory for Grants, New Mexico.
10. De Voto, Richard H. March, 1978. Uranium Geology and Exploration; Colorado School of Mines, Golden Colorado
11. Hilpert, Lowell S., 1969. Uranium Resources of Northwestern New Mexico (Geological Survey Professional Paper 603).
12. Becker, Dr. Robert, 1985. Preliminary Average Annual Lake Evaporation for the Navajo Reservation in inches of Water.
13. 40 CFR Parts 190 to 299, July, 1987. Protection of the Environment: 1-year 24-Hour Rainfall (inches).
14. Molloy, P., April 11, 1990. Field Notes for Haystack Community Field Reconnaissance.

15. Eberline, December, 1987. Radiation Protection Catalog: Instrumentation specification Excerpts.
16. Contact Report, May 10, 1990. To: Mike Holona, Ranger, Navajo Fish and Wildlife. From: Patrick Holloy, Health Physicist, Navajo Superfund Office. Re: Fisheries, Hunt Units and Recreational areas in Haystack Mountain Area.
17. Contact Report, 1989. To: Rich Koch, Geologist, Navajo Nation Minerals Department. From: Patrick Holloy, Navajo Superfund Department. Re: Leases-Navajo Lands Uranium Mines.
18. Holloy, P., May, 1990. Field Notes for Haystack Community Reconnaissance.
19. Navajo Nation Water Resources Division, Various Dates. Pertinent Excerpts from NNWRD Water Well Records.
20. US Geological Survey Waterdata Report NM-88-1, 1988. Water Resources Data for the Rio San Jose at Grants, New Mexico.
21. US Department of Health, Education and Welfare, Indian health Service, June, 1978. "As Built" Water System for Haystack, Navajo Nation, New Mexico.
22. CRC Press, 1989. Handbook of Chemistry and Physics.
23. The Merck Index, Tenth Edition, 1983. Windholz, W. ed., Merck and company Inc., Rathway, N.J.
24. Groundwater Prospecting for Sandstone-Type Uranium Deposits: A Preliminary Comparison of the Merits of Mineral-Solutions Equilibria, and Single-Element Tracer Methods, D. Langmuir and J.R. Chetham. May 1980.
25. The Thermodynamic Properties of Radium, Donald Langmuir, Department of Chemistry and Geochemistry, Colorado School of Mines, Golden Colorado, and Riese, Arthur C., Atlantic Richfield Company, Corporate Technology, Los Angeles, CA., April 1985.
26. Geochemistry of Selenium: Formation of Ferroselite and Selenium Behavior in the Vicinity of Oxidizing Sulfide and Uranium Deposits, Howard, J. Hatten, III., Department of Geology, University of Georgia, Athens, GA., July 1977
27. The Mobility of Thorium in Natural Waters at Low Temperatures, Langmuir, Donald, Department of Chemistry and Geochemistry, Colorado School of Mines, Golden, CO., and Herman, Janet S., Department of Geosciences, The Pennsylvania State University, University Park, PA., July 1980.
28. Agency for Toxic Substances and Disease registry (ATSDR) US

Public Health Service, March, 1990. Toxicological Profile for Arsenic (EXCERPTS).

29. ATSDR, Public Health Services, July 1989. Toxicological Profile for Chromium (Excerpts).
30. New Mexico Bureau of Mines and Mineral Resources, 1979. Open File Report OFR - 90. Descriptions of sections measured for Hydrogeologic study of the San Juan Basin, Northwest New Mexico
31. Navajo Nation, 1988. Navajo Nation Fax '88: A Statistical Abstract. Prepared by Technical Support Department, Window Rock, Navajo Nation, Arizona 86515.
32. Thaden, Robert E. and Ostling, Earl J. 1967. Geologic map of the Bluewater Quadrangle, Valencia and McKinley Counties, New Mexico.
33. US EPA, 1984. Uncontrolled Hazardous Waste Site Ranking System, Users Manual (HW-10).
34. Contact Report, May 29, 1990. To; Patrick Antonio, NSO Staff Hydrogeologist. From; Patrick Molloy, NSO staff Health Physicist. Re; Influence of faults in the Haystack area on Groundwater Hydrogeology (considered opinion).

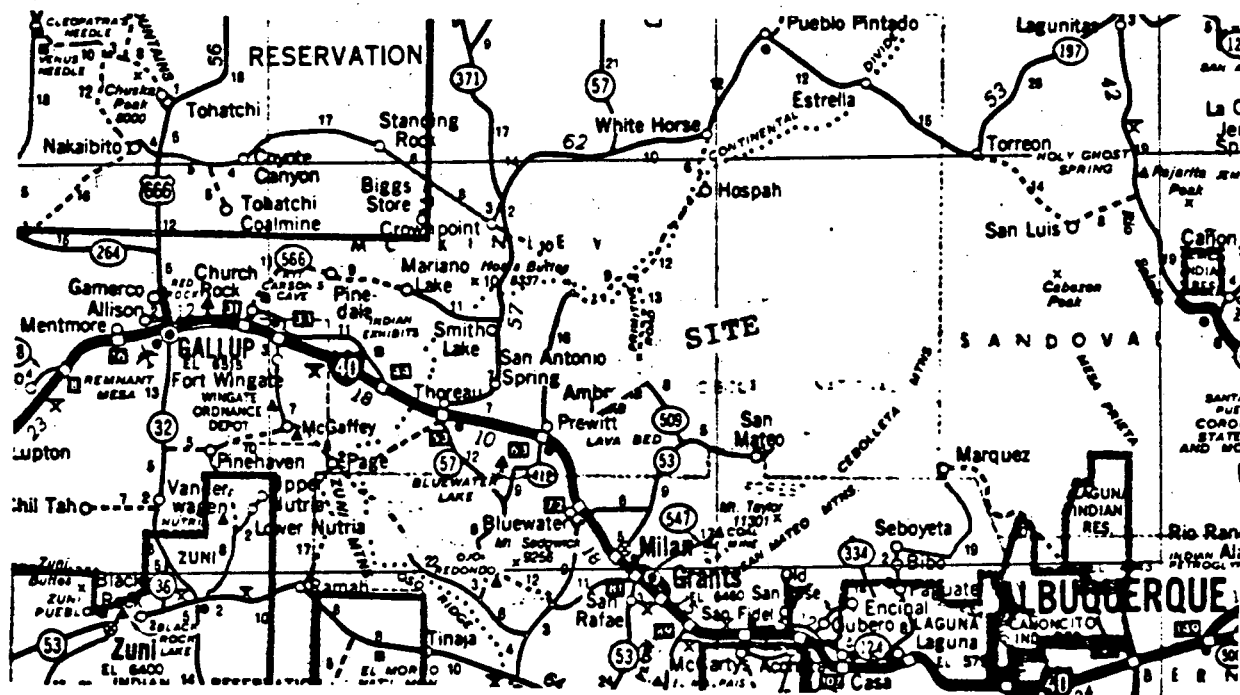


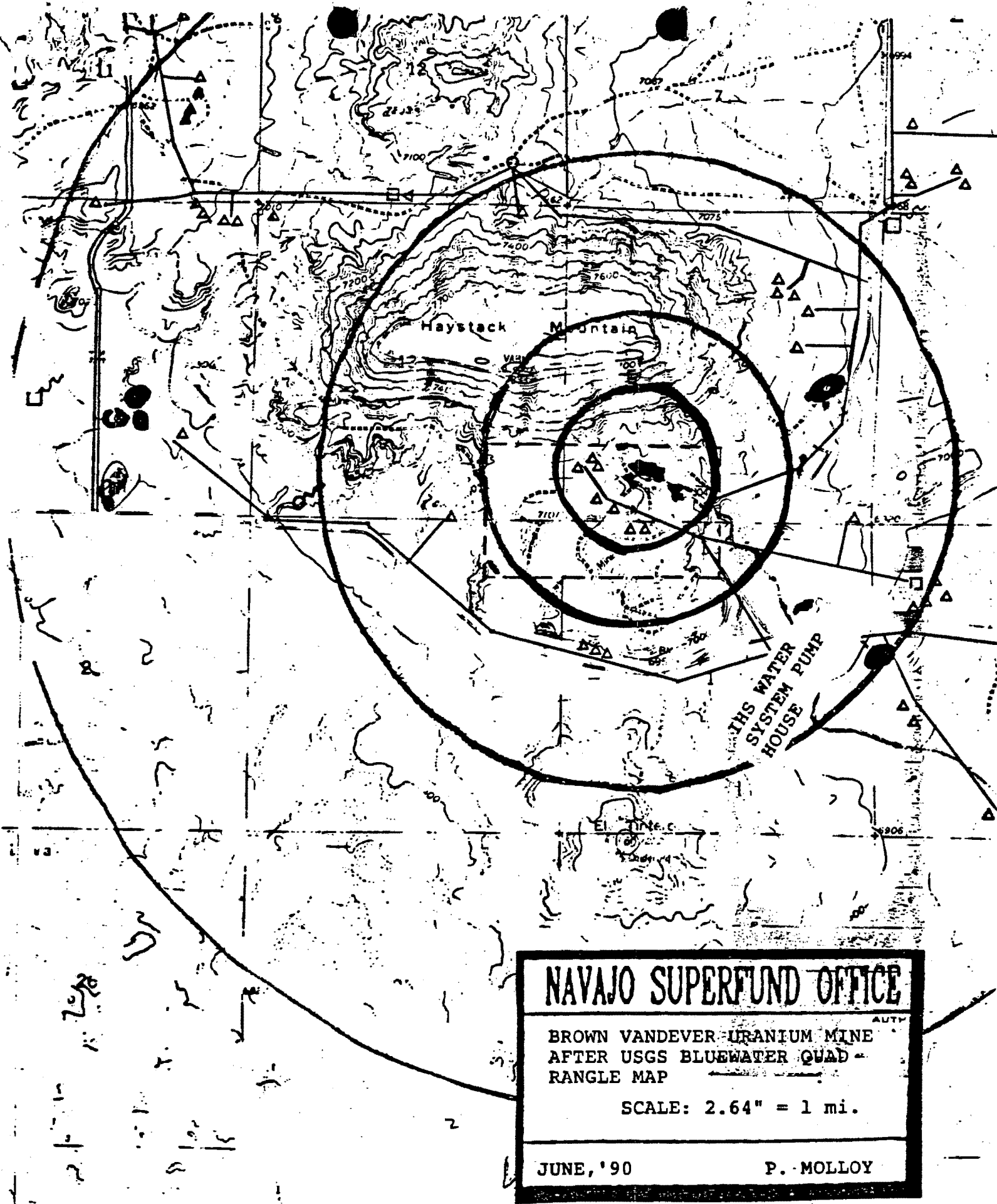
FIGURE # 1 ; REPRINTED BY PERMISSION

NAVAJO SUPERFUND OFFICE

NAVAJO-BROWN VANDEV-  
ER URANIUM MINE

JUNE, '90

P. MOLLOY



# NAVAJO SUPERFUND OFFICE

BROWN VANDEVER URANIUM MINE  
AFTER USGS BLUEWATER QUAD -  
RANGLE MAP

SCALE: 2.64" = 1 mi.

JUNE, '90

P. MOLLOY

Figure 2. Brown-Vandever Mine Site

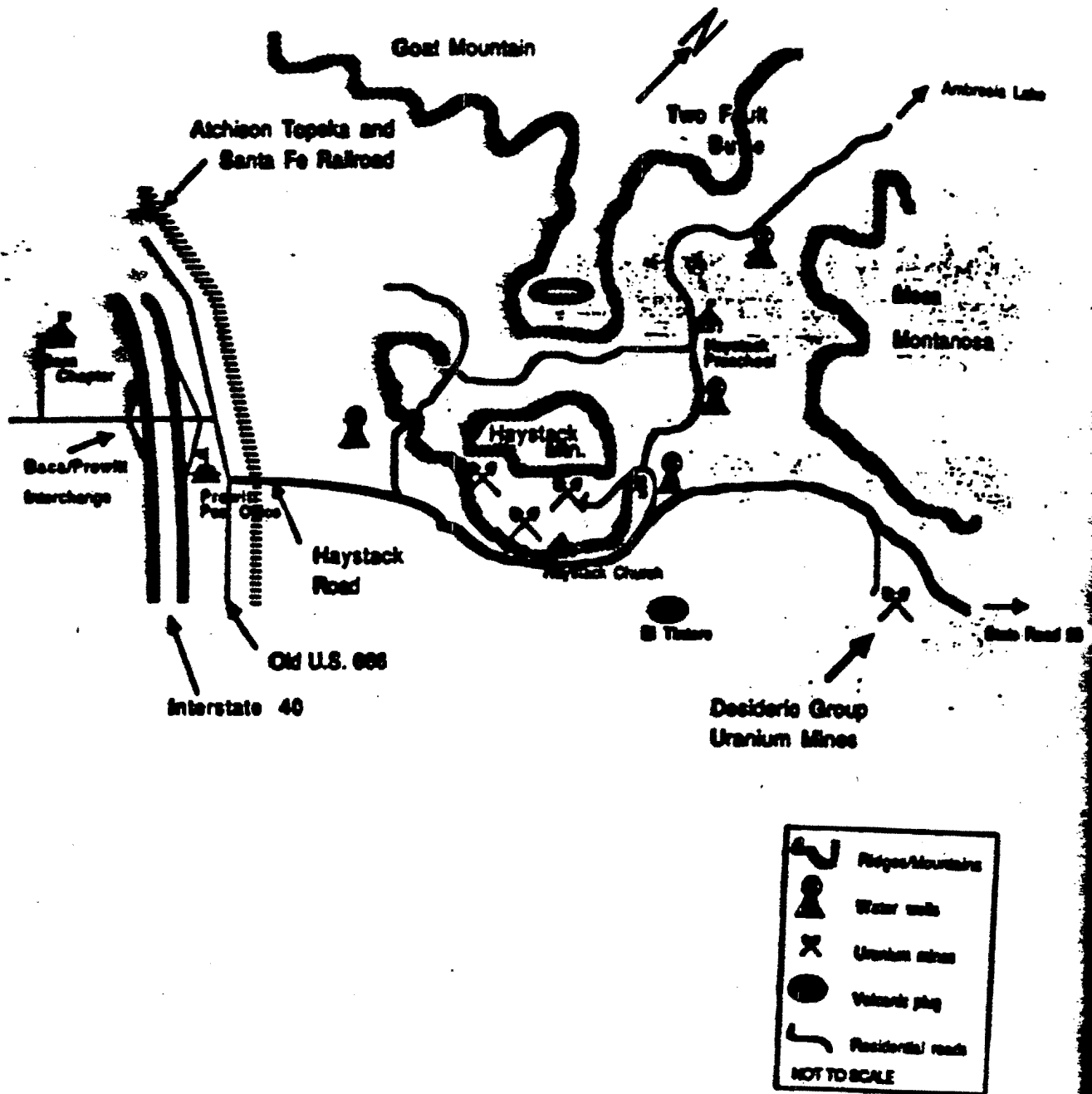


Figure 3

TABLE 1  
GAMMA RADIATION SURVEY DATA  
BROWN-VANDEVER MINE SITE, NAVAJO NATION

NOVEMBER 14-15, 1990

Operator - Collen Petullo      Recorder - Robert Bornstein  
Instrument      ID#      Calibration date      Calibration Source  
1 Ludlum 19      452663      11-08-90      Ra-226  
2 Bicron      825481      10-15-90      Cs-137  
3 Ludlum 12      140830      11-08-90      Pu-239, Sr-90  
Pancake

Date 11/14/90      SECTION 1

Inst.	Time	Station	Ground	Waist	Comments
1 3	0900 0903	Background1	11 uR/hr 100 cpm	11 uR/hr 100 cpm	2.5 mi from site.
1 3	0908 0910	Background2	11 uR/hr 100 cpm	11 uR/hr 100 cpm	1.0 mi from site.
1	0930	Brown Home	13 uR/hr	14 uR/hr	stage area
1 2	1000 1001	Station 1	35 uR/hr 25 urem/hr	36 uR/hr 25 urem/hr	Center of dirt road
1 2	1003 1004	Station 2	130 uR/hr 70 urem/hr	135 uR/hr 60 urem/hr	near tree
1 2	1007 1008	Station 3	90 uR/hr 50 urem/hr	N/A N/A	contact on ground
1 2	1010 1011	Station 4	115 uR/hr* 75 urem/hr	100 uR/hr # 50 urem/hr	
1 2	1015 1017	Station 5	130 uR/hr 85 urem/hr	145 uR/hr 60 urem/hr	
1 2	1019 1020	Station 6	1200 uR/hr 800 urem/hr	800 uR/hr 400 urem/hr	In pit zone
1 2	1028 1033	Station 7	40 uR/hr 20 urem/hr	44 uR/hr 25 urem/hr	Away from pit area
1 2	1040 1044	Station 8	150 uR/hr 90 urem/hr	140 uR/hr 72 urem/hr	

Table 1. (Continued)

Inst.	Time	Station	Ground	Waist	Comments
1 2	1055 1057	Station 9	190 uR/hr 120 urem/hr	170 uR/hr 90 urem/hr	
1 2	1105 1108	Station 10	1250 uR/hr 750 urem/hr	800 uR/hr 350 urem/hr	open area
1 2	1113 1115	Station 11	400 uR/hr 300 urem/hr	200 uR/hr 150 urem/hr	
1 2	1118 1120	Station 12	600 uR/hr 500 urem/hr	500 uR/hr 300 urem/hr	
1 2	1122 1124	Station 13	500 uR/hr 250 urem/hr	500 uR/hr 400 urem/hr	
1 2	1127 1128	Station 14	600 uR/hr 300 urem/hr	700 uR/hr 300 urem/hr	
1 2	1134 1136	Station 15	230 uR/hr 150 urem/hr	280 uR/hr 150 urem/hr	
1 2	1140 1141	Station 16	700 uR/hr 300 urem/hr	600 uR/hr 250 urem/hr	
1 2	1150 1151	Station 17	80 uR/hr 40 urem/hr	120 uR/hr 35 urem/hr	
1 2	1155 1156	Station 18	90 uR/hr 50 urem/hr	65 uR/hr 35 urem/hr	
1 2	1300 1303	Station 19 SECTION 2	700 uR/hr 450 urem/hr	600 uR/hr 350 urem/hr	
1 2	1306 1309	Station 20	900 uR/hr 650 urem/hr	800 uR/hr 500 urem/hr	on pad
1 2	1314 1315	Station 21	300 uR/hr 250 urem/hr	230 uR/hr 150 urem/hr	attic
1 2	1320 1321	Station 22	230 uR/hr 130 urem/hr	210 uR/hr 100 urem/hr	edge of pile
1 2	1330 1334	Station 23	120 uR/hr 40 urem/hr	50 uR/hr 40 urem/hr	

Table 1. (Continued)

Inst.	Time	Station	Ground	Waist	Comments
1 2	1346 1348	Station 24	220 uR/hr 120 urem/hr	220 uR/hr 110 urem/hr	
1 2	1350 1352	Station 25	500 uR/hr 250 urem/hr	400 uR/hr 175 urem/hr	
1 2	1358 1400	Station 26	300 uR/hr 170 urem/hr	300 uR/hr 170 urem/hr	
1 2	1405 1408	Station 27	250 uR/hr 150 urem/hr	200 uR/hr 150 urem/hr	
1 2	1320 1322	Station 28 SECTION 3	10 uR/hr 5 urem/hr	10 uR/hr 5 urem/hr	11/15/90
1 2	1330 1330	Station 29	N/A	13 uR/hr 10 urem/hr	at window of vent
1 2	1333 1334	Station 30	80 uR/hr 50 urem/hr	80 uR/hr 50 urem/hr	lots of stones
1 3	1337 1338	Station 31	75 uR/hr 300 uR/hr	Lgm micro	on casing in hole
1 2	1345	Station 32	350 - 90 uR/hr on brick wall 250 - 50 urem/hr on brick wall		
1 2	1355 1400	Station 33 SECTION 4	15 uR/hr 10 urem/hr	15 uR/hr 10 urem/hr	
1 2	1405 1407	Station 34	125 uR/hr 90 urem/hr	90 uR/hr 50 urem/hr	
1 2	1410 1411	Station 35	25 uR/hr 10 urem/hr	25 uR/hr 10 urem/hr	
1 2	1415 1417	Station 36	225 uR/hr* 130 urem/hr	110 uR/hr# 70 urem/hr	on wall face
1 2	1420 1423	Station 37	600 uR/hr 300 urem/hr	600 uR/hr 300 urem/hr	dug area
1 2	1430 1433	Station 38	240 uR/hr 200 urem/hr	200 uR/hr 240 urem/hr	

Table 1. (Continued)

Inst.	Time	Station	Ground	Waist	Comments
1 2	1440 1443	Station 39	18 uR/hr 10 urem/hr	18 uR/hr 10 urem/hr	
1 2	1446 1448	Station 40	700 uR/hr 600 urem/hr	600 uR/hr 300 urem/hr	
1 2	1452 1453	Station 41	500 uR/hr* 350 urem/hr	400 uR/hr# 250 urem/hr	

\* On contact with rock/tailing outcrop

# 3 feet from contact

## DESIDERIO MINE SITE, NAVAJO NATION

NOVEMBER 15, 1990

Operator - Collen Petullo Recorder - Vicky Radvilla

Instrument ID# Calibration date Calibration Source

1 Ludlum 19 452663 11-08-90 Ra-226

2 Bicron 825481 10-15-90 Cs-137

3 Ludlum 12 140830 11-08-90 Pu-239, Sr-90

Pancake

Date 11/15/90 SECTION 1

Inst.	Time	Station	Ground	Waist	Comments
1 3	0825	Background1	11 uR/hr 100 cpm	11 uR/hr 100 cpm	2.5 mi from site
1 3	0830	Background2	11 uR/hr 100 cpm	11 uR/hr 100 cpm	1.0 mi from site
1 2	0855 0856	Station 1	12 uR/hr 7 urem/hr	12 uR/hr 6 urem/hr	at pond site
1 2	0857 0859	Station 2	18 uR/hr 8 urem/hr	18 uR/hr 8 urem/hr	at fence
1 2	0940 0941	Station 3	10 uR/hr 5 urem/hr	10 uR/hr 5 urem/hr	at base station
1 2	0955 0956	Station 4	20 uR/hr 7 urem/hr	24 uR/hr 7 urem/hr	large pit

Table 1. (Continued)

1 2	1000 1001	Station 5@	90 uR/hr 50 urem/hr	75 uR/hr 40 urem/hr	pile near St. 4
1 2	1045 1046	Station 6@	135 uR/hr 75 urem/hr	120 uR/hr 60 urem/hr	
1 2	1055 1056	Station 7@	85 uR/hr 50 urem/hr	75 uR/hr 40 urem/hr	
1 2	1058 1100	Station 8	170 uR/hr 90 urem/hr	120 uR/hr 60 urem/hr	
1 2	1105	Station 9			sediment only
<b>Inst.</b>	<b>Time</b>	<b>Station</b>	<b>Ground</b>	<b>Waist</b>	<b>Comments</b>
1 2	1107	Station 10			sediment only
1 2	1153 1154	Station 11	55 uR/hr 30 urem/hr	55 uR/hr 30 urem/hr	
1 2	1214 1215	Station 12	900 uR/hr 400 urem/hr	400 uR/hr 250 urem/hr	near attic

@ radon flux canister area

TABLE 2  
EPA ERS PRELIMINARY ASSESSMENT LABORATORY RESULTS  
NAVAJO-BROWN-VANDEVER  
NOVEMBER 15-16, 1990

SAMPLE LOCATION	ID#	RADIONUCLIDE	RESULTS	UNITS
(WATER SAMPLES) Brown Vandever Livestock Well B-V)	W1	Ra(226) Ra(228) U(233-4) U(235) U(238)	00.8 ± 0.1 2.0 ± 5.0 2.0 ± 0.4 00.3 ± 0.1 0.4 ± 0.2	pCi/l
B-V Livestock Well	W2	Ra(226) Ra(228) U(233-4) U(235) U(238)	00.2 ± 0.1 0.0 ± 5.0 0.5 ± 0.2 00.0 ± 0.1 00.0 ± 0.1	pCi/l
B-V Tap Water	W3	Ra(226) Ra(228) U(233-4) U(235) U(238)	00.2 ± 0.1 0.0 ± 5.0 2.1 ± 0.5 1.0 ± 0.3 0.8 ± 0.3	pCi/l
Water Line B-V	W4	Ra(226) Ra(228) U(233-4) U(235) U(238)	.1 ± 0.1 0 ± 5 1.4 ± 0.4 0.5 ± 0.2 0.5 ± 0.2	pCi/l
Desiderio Stock Pond	W5	Ra(226) Ra(228) U(233-4) U(235) U(238)	.3 ± 0.1 0 ± 5 2.3 ± 0.4 0.1 ± 0.2 2.2 ± 0.2	pCi/l
Desiderio Tap	W6	Ra(226) Ra(228) U(233-4) U(235) U(238)	.3 ± 0.1 0 ± 5 1.2 ± 0.4 0.0 ± 0.2 0.2 ± 0.2	pCi/l
Preschool Well (EXCEEDS DRINKING WATER STANDARDS: POTENTIAL LAB/ SAMPLING ERROR, ADVISE IMMEDIATE RESAMPLING)	W7	Ra(226) Ra(228) U(233-4) U(235) U(238)	1.0 ± 0.1 22.0 ± 6 130.0 ± 10 3.0 ± 0.5 74.0 ± 7	pCi/l

Table 2. (Continued)  
SAMPLE LOCATION ID#

SOIL SAMPLES  
RADIONUCLIDE RESULTS UNITS

BACKGROUND Road to B-V	A9	Ra(226)	00.8 ± 00.1	pCi/g
		Ra(228)	0.0 ± 01.0	
		U(233-4)	0.6 ± 00.1	
		U(235)	00.0 ± 0.1	
		U(238)	000.7 ± 00.1	
Station 20 (Section 2) B-V	1A	Ra(226)	300.0 ± 10.0	pCi/g dry
		Ra(228)	1.0 ± 01.0	
		U(233-4)	240.0 ± 20.0	
		U(235)	13.0 ± 1.0	
		U(238)	250.0 ± 20.0	
Station 22 (Tailing Pile) Section 2 B-V	2A	Ra(226)	34.0 ± 3.0	pCi/g dry
		Ra(228)	0.0 ± 1.0	
		U(233-4)	25.0 ± 2.0	
		U(235)	1.0 ± 0.2	
		U(238)	25.0 ± 2.0	
Station 23 (Drainage Area) Section 2 B-V	3A	Ra(226)	24.0 ± 2.0	pCi/g
		Ra(228)	0.0 ± 1.0	
		U(233-4)	21.0 ± 2.0	
		U(235)	.8 ± 0.1	
		U(238)	20.0 ± 2.0	
Station 25 (Upper Drainage) Section 2 B-V	4A	Ra(226)	4.7 ± 0.5	pCi/g
		Ra(228)	0.0 ± 1.0	
		U(233-4)	3.4 ± 0.4	
		U(235)	.1 ± 0.1	
		U(238)	3.5 ± 0.4	
Station 6 (Pebble Area) Section 1 B-V	5A	Ra(226)	49.0 ± 5.0	pCi/g
		Ra(228)	.0 ± 1.0	
		U(233-4)	24.0 ± 2.0	
		U(235)	1.0 ± 0.2	
		U(238)	25.0 ± 2.0	
Station 10 (Strip Area) Section 1 B-V	6A	Ra(226)	130.0 ± 10.0	pCi/g
		Ra(228)	0.0 ± 1.0	
		U(233-4)	100.0 ± 20.0	
		U(235)	4.7 ± 0.5	
		U(238)	100.0 ± 10.0	

Table 2. (Continued)

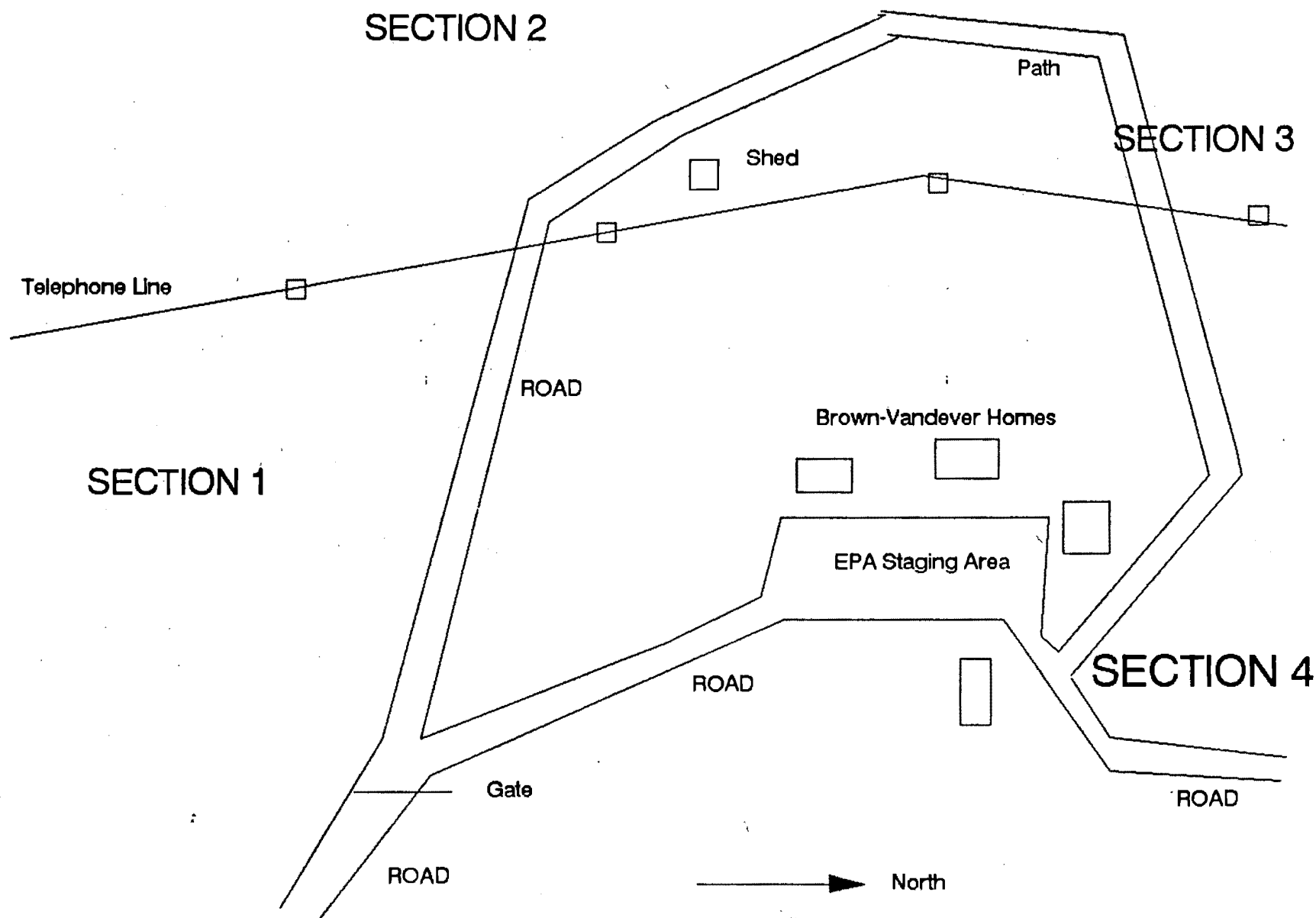
SAMPLING LOCATION ID#		RADIONUCLIDE	RESULTS	UNITS
Station 11 Section 1 B-V	7A	Ra(226)	260.0 $\pm$ 10.0	pCi/g
		Ra(228)	1.0 $\pm$ 1.0	
		U(233-4)	290.0 $\pm$ 30.0	
		U(235)	20.0 $\pm$ 2.0	
		U(238)	310.0 $\pm$ 30.0	
Wash Area Near B-V	8A	Ra(226)	1.9 $\pm$ 0.2	pCi/g
		Ra(228)	1.0 $\pm$ 1.0	
		U(233-4)	1.1 $\pm$ 0.1	
		U(235)	00.0 $\pm$ 0.1	
		U(238)	1.1 $\pm$ 0.2	
Background For Desiderio Road to Desiderio	10A	Ra(226)	1.3 $\pm$ 0.1	pCi/g
		Ra(228)	0.0 $\pm$ 1.0	
		U(233-4)	0.6 $\pm$ 0.1	
		U(235)	00.0 $\pm$ 0.1	
		U(238)	0.8 $\pm$ 0.2	
Radon Flux Area Desiderio	12A	Ra(226)	34.0 $\pm$ 3.0	pCi/g
		Ra(228)	0.0 $\pm$ 1.0	
		U(233-4)	17.0 $\pm$ 2.0	
		U(235)	00.7 $\pm$ 0.1	
		U(238)	17.0 $\pm$ 0.2	
Radon Flux Area Desiderio	13A	Ra(226)	30.0 $\pm$ 3.0	pCi/g
		Ra(228)	0.0 $\pm$ 1.0	
		U(233-4)	17.0 $\pm$ 2.0	
		U(235)	00.0 $\pm$ 0.1	
		U(238)	1.1 $\pm$ 0.2	
Station 11 Desiderio	14A	Ra(226)	1.8 $\pm$ 0.2	pCi/g
		Ra(228)	0.0 $\pm$ 0.6	
		U(233-4)	0.6 $\pm$ 0.1	
		U(235)	0.0 $\pm$ 0.1	
		U(238)	0.7 $\pm$ 0.1	
Station 12 Desiderio	15A	Ra(226)	3.0 $\pm$ 0.3	pCi/g
		Ra(228)	0.0 $\pm$ 1.0	
		U(233-4)	1.7 $\pm$ 0.2	
		U(235)	0.1 $\pm$ 0.1	
		U(238)	1.5 $\pm$ 0.1	

Table 2. (Continued)  
 SAMPLING LOCATION ID#

		RADIONUCLIDE	RESULTS		UNITS
Station 30 Drainage near Station 30 B-V Section 3	18A	Ra(226)	0.8 $\pm$	0.1	pCi/g
		Ra(228)	1.0 $\pm$	1.0	
		U(233-4)	0.7 $\pm$	0.1	
		U(235)	0.1 $\pm$	0.1	
		U(238)	0.8 $\pm$	0.1	
Station 36 On Tailing Outcrop B-V Section 3	19A	Ra(226)	20.0 $\pm$	2.0	pCi/g
		Ra(228)	0.0 $\pm$	1.0	
		U(233-4)	28.0 $\pm$	3.0	
		U(235)	1.2 $\pm$	0.2	
		U(238)	28.0 $\pm$	3.0	
Duplicate of 19A	20A	Ra(226)	33.0 $\pm$	3.0	pCi/g
		Ra(228)	0.0 $\pm$	1.0	
		U(233-4)	29.0 $\pm$	3.0	
		U(235)	1.3 $\pm$	0.2	
		U(238)	28.0 $\pm$	3.0	
Station 40 Section 4 B-V	21A	Ra(226)	450.0 $\pm$	50.0	pCi/g
		Ra(228)	0.0 $\pm$	01.0	
		U(233-4)	330.0 $\pm$	30.0	
		U(235)	29.0 $\pm$	3.0	
		U(238)	390.0 $\pm$	40.0	

Laboratory -- TMA Eberline  
 7021 Pan American Freeway, N.E.  
 Albuquerque, NM

# SAMPLING SECTION LOCATIONS, BROWN-VANDEVER MINE SITE



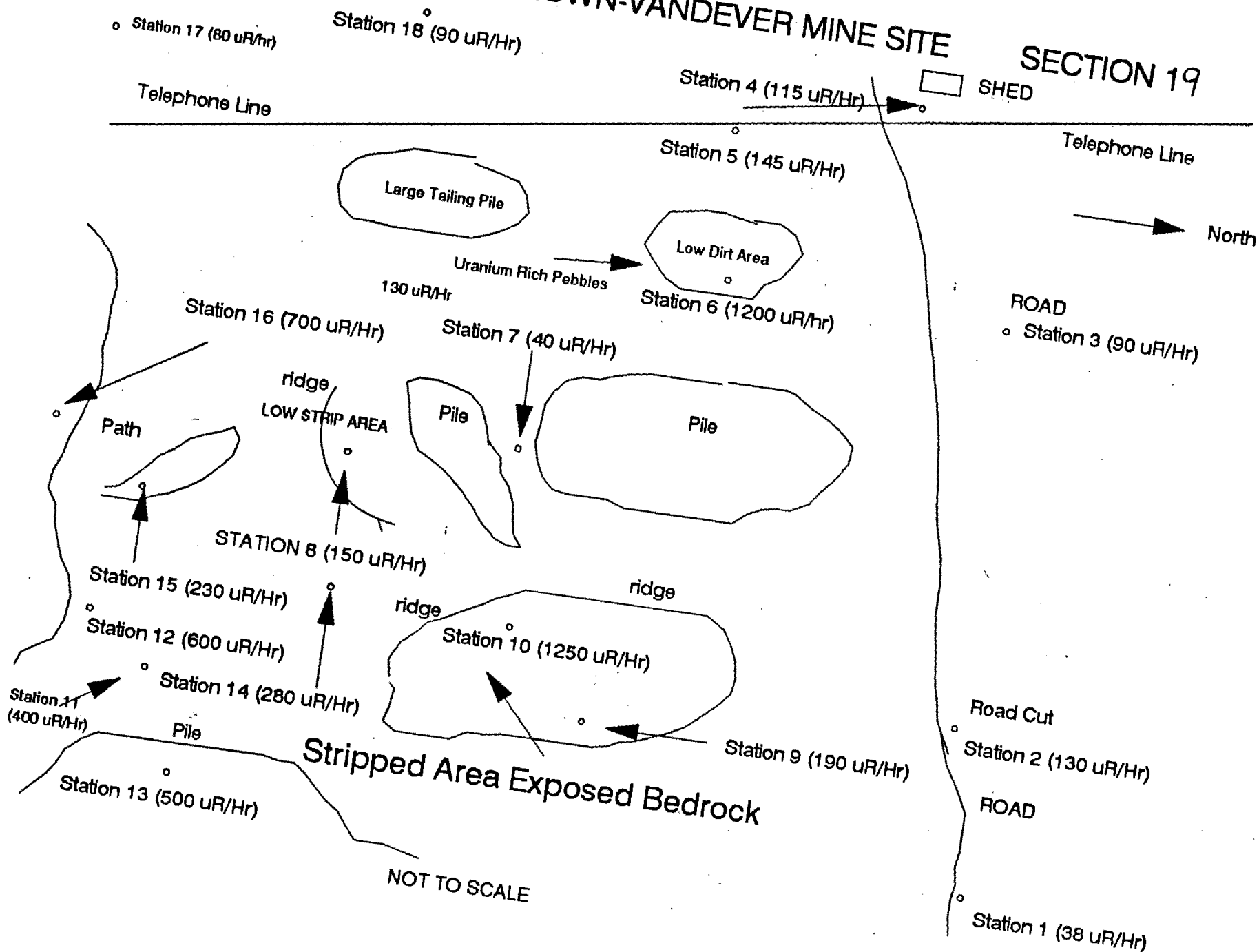
NOT TO SCALE

EPA SURVEY, NOVEMBER 1990

Figure 4. Section Location Map

# SAMPLE LOCATIONS, BROWN-VANDEVER MINE SITE

SECTION 19



# SAMPLE LOCATIONS, BROWN-VANDEVER MINE SITE

## SECTION 2

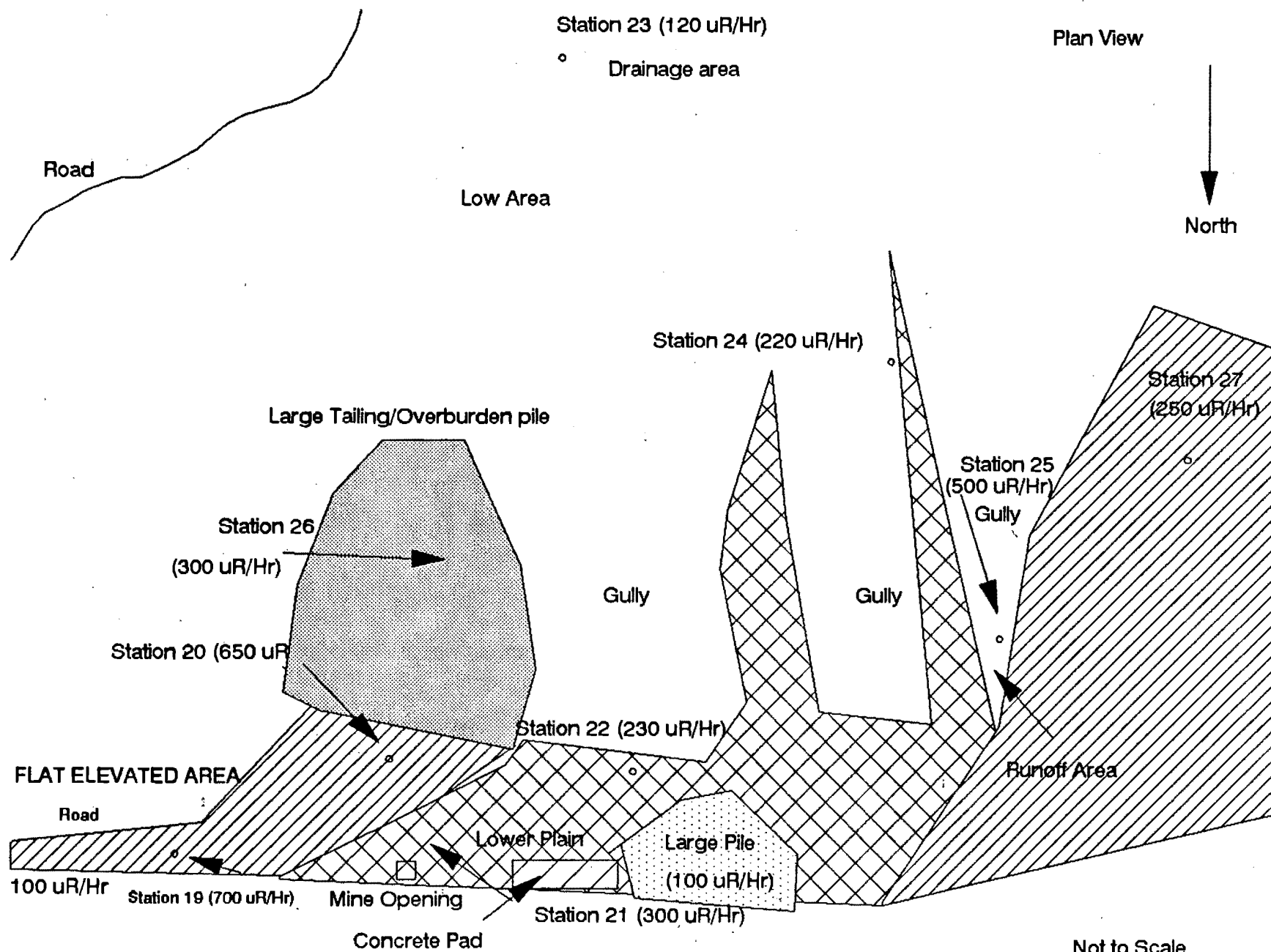


Figure 6. Section 2 B-V.

# SAMPLING STATIONS, BROWN-VANDEVER MINE SITE SECTION 3

HAYSTACK MOUNTAIN

North

VENTILATION SHAFT

Station 29 (130 uR/Hr)

Station 30 (80 uR/Hr)

Power Line

CONCRETE PAD

Station 31 (200 uR/Hr)

Air Ducts

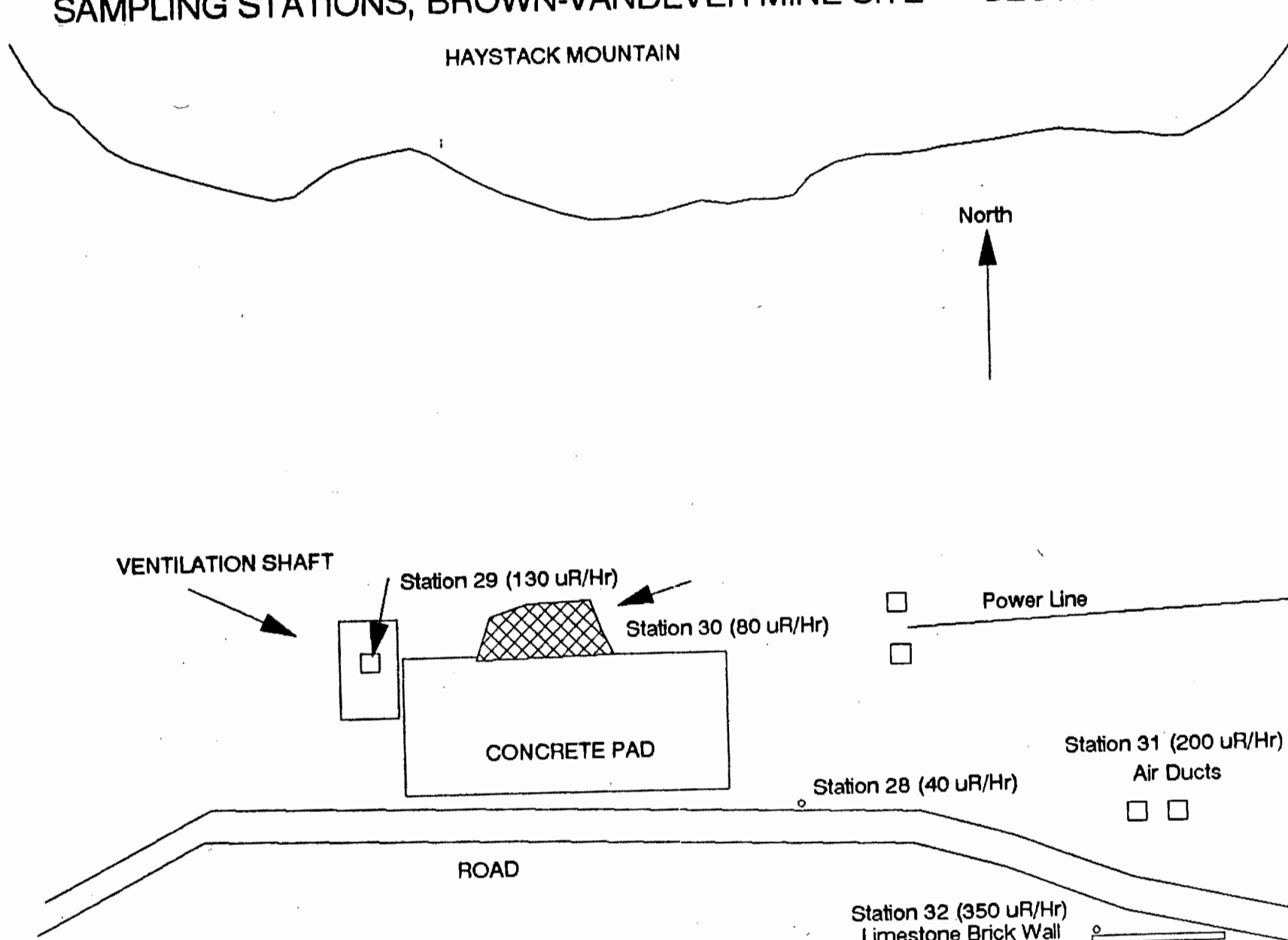
Station 28 (40 uR/Hr)

ROAD

Station 32 (350 uR/Hr)  
Limestone Brick Wall

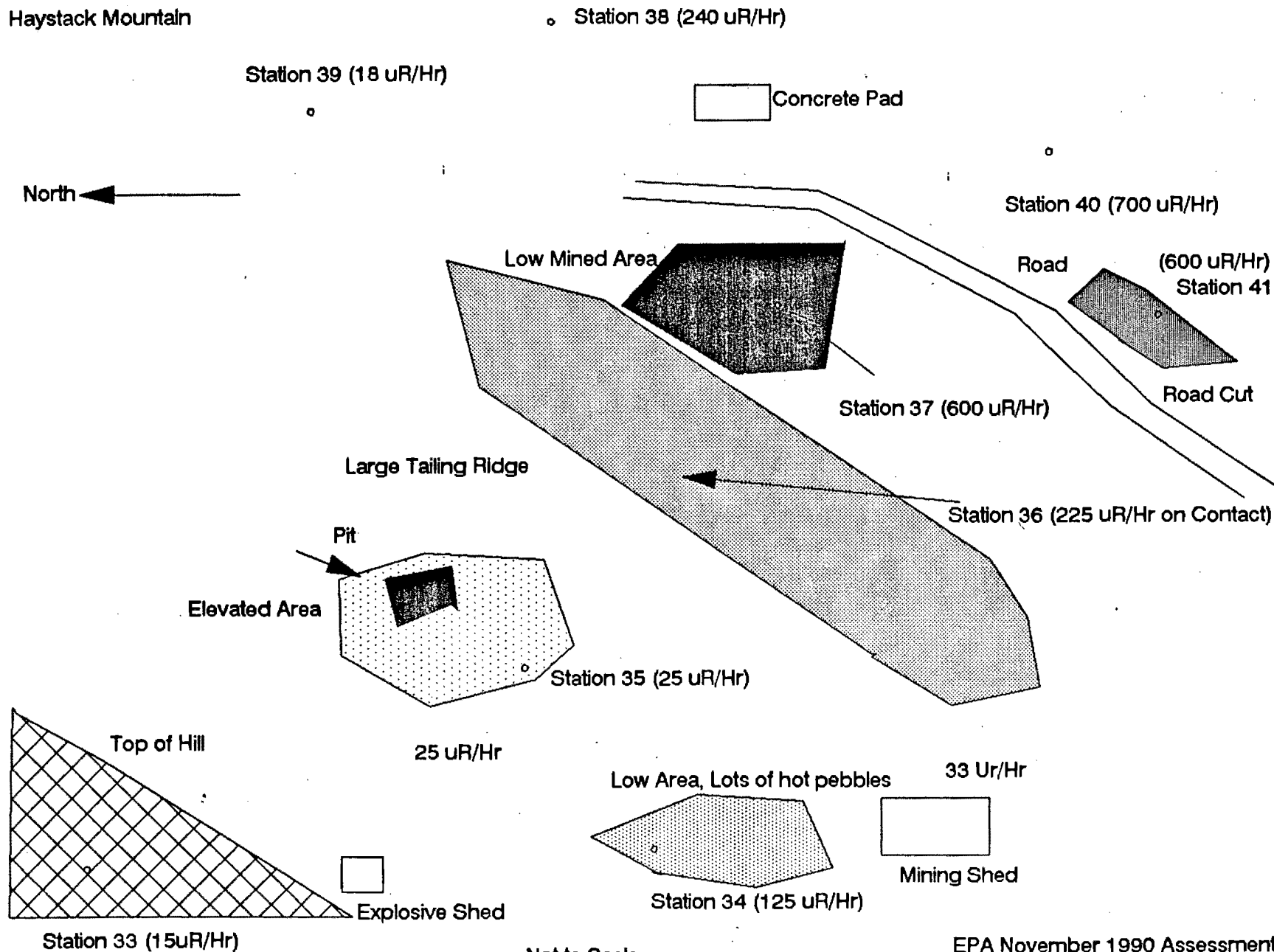
Not to Scale

Figure 7. Section 3 B-V.



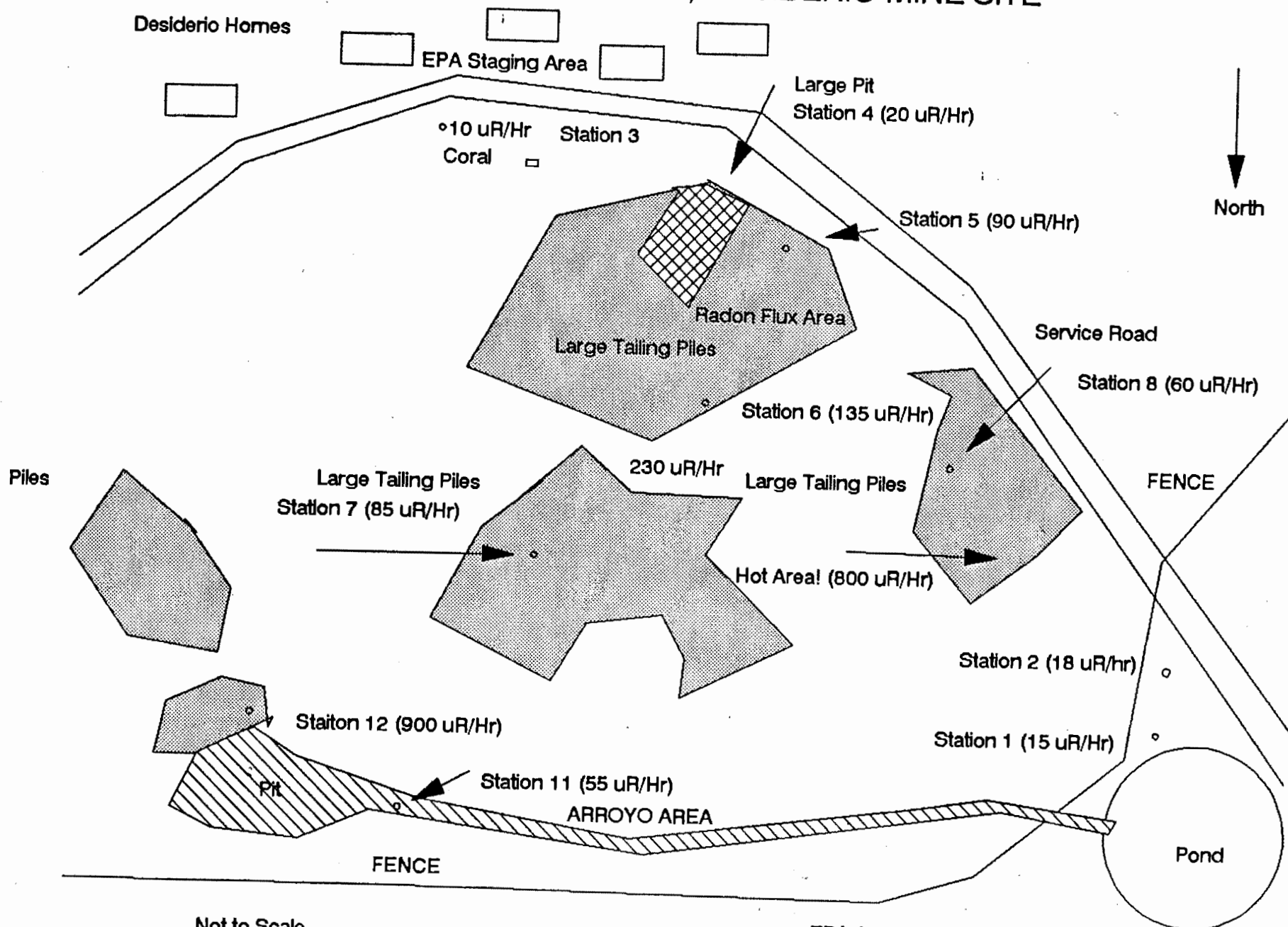
# SAMPLING STATIONS, BROWN-VANDEVER MINE SITE SECTION 4

Haystack Mountain



EPA November 1990 Assessment  
Figure 8. Section 4 B-V.

# SAMPLING STATIONS, DESIDERIO MINE SITE



EPA Assessment November 1990  
Figure 9. Desiderio Mine Site.

APPENDIX A

OF



## SCIENTIFIC ANALYSIS, INC.

November 30, 1990

Ms. Mary Sue Philp  
Ecology & Environment  
160 Spear St.  
San Francisco, CA 94105

Subject: Results of Radon Flux Testing  
Navajo Uranium Mine Sites  
New Mexico

Dear Ms. Philp:

Scientific Analysis, Inc., is pleased to provide you with the results of 50 radon flux measurements performed on November 15-16, 1990 on three Navajo uranium mine sites using the 4" charcoal canister device (SAACC). While the SAACC procedure is not an EPA approved method, side by side measurements using the SAACC and the EPA approved procedure (LAACC) demonstrate comparable results when respective arithmetic means are computed and compared with each other.

The arithmetic mean radon flux levels were 51.4, 67.0, and 47.7 pCi/m<sup>2</sup>-s, respectively for stations 5, 6, and 7. For comparison purposes, the 40 CFR Part 61 standard for operating uranium mill tailings piles limits radon emissions to 20 pCi/m<sup>2</sup>-s.

Individual flux results are presented in the attached Tables Tx where the prefix NU5 refers to Navajo Uranium Station 5, NU6 refers to Navajo Uranium Station 6, and NU7 refers to Navajo Uranium Station 7. Each table is divided into subparts (v) valid test results, (d) duplicate test results to demonstrate counting precision, and (b) "blank" results to check internal quality control. Based on counting results, measurements identified as NU5-20404, NU6-20420, and NU7-20433 are most likely blanks (i.e. unexposed SAACC).

Table QA outlines the quality assurance results. Sampling conditions such as ambient temperature and rainfall are unknown to SAI but are assumed to be within the limits prescribed in the SAACC procedure. In addition, a copy of the sample chain of custody form is included for your files.

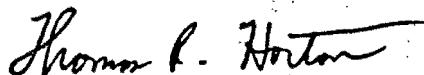
If you have any questions regarding these results and this letter report, please do not hesitate to call me. All data and reports

Ms. Mary Sue Philp  
November 30, 1990  
Page 2

will be treated as confidential and will not be released without  
your written approval.

Sincerely,

SCIENTIFIC ANALYSIS, INC.



Thomas R. Horton  
Radiation Consultant

TH/rlr

attach: Table (4)

**Table QA**  
**Quality Assurance Results**

<u>Mine Stations</u>	<u>% Completeness</u>	<u>Counting % Precision</u>	<u>Blank (Blind) Identification</u>
Overall	100	0.2	*

\*All blanks (blinds) were presumably found and calculated to have an equivalent flux of zero.



**SCIENTIFIC ANALYSIS, INC.**

**U.S. EPA LISTED  
RADON LABORATORY**

**SUMMARY OF RADON FLUX COMPUTATIONS**  
**TABLE IV. VALID TEST RESULTS FOR TOP OF STACK**  
Scientific Analysis, Inc.; Montgomery, Alabama 36117

11/27/90

Detector	On Stack	Off Stack	Count Begun	Counter Eff.	Gross Cnts	Background	Flux
WU5-20384	11/15/90 11:38 am	11/16/90 10:17 am	11/20/90 09:14 am	0.1659	56136	616	52.9
WU5-20385	11/15/90 11:40 am	11/16/90 10:17 am	11/20/90 09:26 am	0.1659	65891	616	62.3
WU5-20386	11/15/90 11:32 am	11/16/90 10:21 am	11/20/90 09:46 am	0.1659	37381	616	34.9
WU5-20387	11/15/90 11:30 am	11/16/90 10:18 am	11/20/90 09:58 am	0.1659	38564	616	36.1
WU5-20388	11/15/90 11:34 am	11/16/90 10:19 am	11/20/90 10:09 am	0.1659	41146	616	38.7
WU5-20389	11/15/90 11:37 am	11/16/90 10:18 am	11/20/90 10:20 am	0.1659	50799	616	48.1
WU5-20390	11/15/90 11:42 am	11/16/90 10:15 am	11/20/90 10:31 am	0.1659	41825	616	39.8
WU5-20391	11/15/90 11:44 am	11/16/90 10:16 am	11/20/90 10:42 am	0.1659	37511	616	35.7
WU5-20392	11/15/90 11:31 am	11/16/90 10:18 am	11/20/90 10:53 am	0.1659	72031	616	68.5
WU5-20393	11/15/90 11:30 am	11/16/90 10:21 am	11/20/90 11:04 am	0.1659	73480	616	69.7
WU5-20394	11/15/90 11:27 am	11/16/90 10:20 am	11/20/90 11:18 am	0.1659	67716	616	64.3
WU5-20395	11/15/90 11:23 am	11/16/90 10:20 am	11/20/90 11:31 am	0.1659	41909	616	39.5
WU5-20396	11/15/90 11:45 am	11/16/90 10:21 am	11/20/90 11:50 am	0.1659	133063	616	129
WU5-20397	11/15/90 11:44 am	11/16/90 10:22 am	11/20/90 12:01 pm	0.1659	124722	616	121
WU5-20398	11/15/90 11:40 am	11/16/90 10:21 am	11/20/90 12:13 pm	0.1659	26268	616	24.9
WU5-20399	11/15/90 11:41 am	11/16/90 10:21 am	11/20/90 12:26 pm	0.1659	70727	616	68.3
WU5-20400	11/15/90 11:48 am	11/16/90 10:13 am	11/20/90 12:39 pm	0.1659	21932	616	21.0
WU5-20401	11/15/90 11:45 am	11/16/90 10:17 am	11/20/90 12:56 pm	0.1659	27380	616	26.3
WU5-20402	11/15/90 11:51 am	11/16/90 10:13 am	11/20/90 01:06 pm	0.1659	19879	616	19.1
WU5-20403	11/15/90 11:48 am	11/16/90 10:23 am	11/20/90 01:18 pm	0.1659	28771	616	27.7

NOTE: All times are local stack times; Counting time is 10 minutes; Flux is given in pCi/Sec-Sq M  
NOTE: Number of Flux Measurements = 20; Average flux = 51.4



**SCIENTIFIC ANALYSIS, INC.**

**U.S. EPA LISTED  
RADON LABORATORY**

**SUMMARY OF RADON FLUX COMPUTATIONS  
TABLE 1d. DUPLICATE TEST RESULTS FOR TOP OF STACK  
Scientific Analysis, Inc.; Montgomery, Alabama 36117**

**11/27/90**

Detector	---- On Stack ----	--- Off Stack ----	-- Count Begun --	Counter Eff.	Gross Cnts	Background	Flux
WU5-20390	11/15/90 11:42 am	11/16/90 10:15 am	11/21/90 11:40 am	0.1647	34465	570	39.9
WU5-20399	11/15/90 11:41 am	11/16/90 10:21 am	11/21/90 11:51 am	0.1647	59115	570	68.6

**NOTE:** All times are local stack times; Counting time is 10 minutes; Flux is given in pCi/Sec-Sq M

**NOTE:** Number of Flux Measurements = 2; Average flux = 54.3



**SCIENTIFIC ANALYSIS, Inc.**

**U.S. EPA LISTED  
RADON LABORATORY**

**SUMMARY OF RADON FLUX COMPUTATIONS  
TABLE Tb. BLANK TEST RESULTS FOR TOP OF STACK  
Scientific Analysis, Inc.; Montgomery, Alabama 36117**

**11/27/90**

Detector	---- On Stack -----	--- Off Stack ----	-- Count Begun ---	Counter Eff.	Gross Cnts	Background	Flux
NU5-20404	11/15/90 11:50 am	11/16/90 10:19 am	11/20/90 01:30 pm	0.1659	627	616	0.0

**NOTE: All times are local stack times; Counting time is 10 minutes; Flux is given in pCi/Sec-Sq M**

**NOTE: Number of Flux Measurements = 1; Average flux = 0.0**

**SCIENTIFIC ANALYSIS, INC.**U.S. EPA LISTED  
RADON LABORATORY

SUMMARY OF RADON FLUX COMPUTATIONS  
TABLE IV. VALID TEST RESULTS FOR TOP OF STACK  
Scientific Analysis, Inc.; Montgomery, Alabama 36117

11/27/90

Detector	--- On Stack ---		--- Off Stack ---		-- Count Begun --		Counter Eff.	Gross Cnts	Background	Flux
HU6-20405	11/15/90	12:05 pm	11/16/90	10:23 am	11/20/90	01:41 pm	0.1659	18532	616	17.9
HU6-20406	11/15/90	12:03 pm	11/16/90	10:23 am	11/20/90	01:52 pm	0.1659	65963	616	65.2
HU6-20407	11/15/90	12:00 pm	11/16/90	10:23 am	11/20/90	02:03 pm	0.1659	88587	616	87.7
HU6-20408	11/15/90	12:01 pm	11/16/90	10:25 am	11/20/90	02:14 pm	0.1659	58818	616	58.1
HU6-20409	11/15/90	12:07 pm	11/16/90	10:27 am	11/20/90	02:25 pm	0.1659	45538	616	45.0
HU6-20410	11/15/90	12:06 pm	11/16/90	10:28 am	11/20/90	09:03 am	0.1638	43613	618	41.8
HU6-20411	11/15/90	12:02 pm	11/16/90	10:26 am	11/20/90	09:14 am	0.1638	84389	618	81.5
HU6-20412	11/15/90	12:04 pm	11/16/90	10:29 am	11/20/90	09:26 am	0.1638	62770	618	60.5
HU6-20413	11/15/90	11:59 am	11/16/90	10:30 am	11/20/90	09:46 am	0.1638	46518	618	44.6
HU6-20414	11/15/90	12:07 pm	11/16/90	10:31 am	11/20/90	09:58 am	0.1638	46848	618	45.2
HU6-20415	11/15/90	12:10 pm	11/16/90	10:28 am	11/20/90	10:09 am	0.1638	57169	618	55.6
HU6-20416	11/15/90	11:55 am	11/16/90	10:25 am	11/20/90	10:20 am	0.1638	57660	618	55.7
HU6-20417	11/15/90	11:58 am	11/16/90	10:25 am	11/20/90	10:31 am	0.1638	146693	618	143
HU6-20418	11/15/90	11:57 am	11/16/90	10:25 am	11/20/90	10:42 am	0.1638	124072	618	121
HU6-20419	11/15/90	11:53 am	11/16/90	10:25 am	11/20/90	10:53 am	0.1638	84129	618	81.8

NOTE: All times are local stack times; Counting time is 10 minutes; Flux is given in pCi/Sec-Sq M  
NOTE: Number of Flux Measurements = 15; Average flux = 67.0



SCIENTIFIC ANALYSIS, INC.

U.S. EPA LISTED  
RADON LABORATORY

SUMMARY OF RADON FLUX COMPUTATIONS  
TABLE 1d. DUPLICATE TEST RESULTS FOR TOP OF STACK  
Scientific Analysis, Inc.; Montgomery, Alabama 36117

11/27/90

Detector	---- On Stack ----	--- Off Stack ---	-- Count Begun --	Counter Eff.	Gross Cnts	Background	Flux
NU6-20410	11/15/90 12:06 pm	11/16/90 10:28 am	11/21/90 11:40 am	0.1642	35937	634	41.9
NU6-20420	11/15/90 11:50 am	11/16/90 10:25 am	11/21/90 11:51 am	0.1642	625	634	0.0

NOTE: All times are local stack times; Counting time is 10 minutes; Flux is given in pCi/Sec-Sq M

NOTE: Number of Flux Measurements = 2; Average flux = 20.9



**SCIENTIFIC ANALYSIS, Inc.**

**U.S. EPA LISTED  
RADON LABORATORY**

**SUMMARY OF RADON FLUX COMPUTATIONS**  
**TABLE Tb. BLANK TEST RESULTS FOR TOP OF STACK**  
**Scientific Analysis, Inc.; Montgomery, Alabama 36117**

**11/27/90**

Detector	---- On Stack ----	--- Off Stack ---	-- Count Begun --	Counter Eff.	Gross Cnts	Background	Flux
NU6-20420	11/15/90 11:50 am	11/16/90 10:25 am	11/20/90 11:04 am	0.1638	640	618	0.0

**NOTE:** All times are local stack times; Counting time is 0 minutes; Flux is given in pCi/Sec-Sq M

**NOTE:** Number of Flux Measurements = 1; Average flux = 0.0



**SCIENTIFIC ANALYSIS, INC.**

**U.S. EPA LISTED  
RADON LABORATORY**

**SUMMARY OF RADON FLUX COMPUTATIONS  
TABLE IV. VALID TEST RESULTS FOR TOP OF STACK  
Scientific Analysis, Inc.; Montgomery, Alabama 36117**

**11/27/90**

Detector	---- On Stack ----		--- Off Stack ---		-- Count Begun --		Counter Eff.	Gross Cnts	Background	Flux
NU7-20421	11/15/90	12:14 pm	11/16/90	10:29 am	11/20/90	11:18 am	0.1638	40588	618	39.7
NU7-20422	11/15/90	12:16 pm	11/16/90	10:29 am	11/20/90	11:31 am	0.1638	67549	618	66.7
NU7-20423	11/15/90	12:18 pm	11/16/90	10:30 am	11/20/90	11:50 am	0.1638	53832	618	53.2
NU7-20424	11/15/90	12:22 pm	11/16/90	10:30 am	11/20/90	12:01 pm	0.1638	29053	618	28.6
NU7-20425	11/15/90	12:22 pm	11/16/90	10:30 am	11/20/90	12:13 pm	0.1638	37118	618	36.7
NU7-20426	11/15/90	12:19 pm	11/16/90	10:30 am	11/20/90	12:26 pm	0.1638	37697	618	37.3
NU7-20427	11/15/90	12:15 pm	11/16/90	10:30 am	11/20/90	12:39 pm	0.1638	42691	618	42.2
NU7-20428	11/15/90	12:18 pm	11/16/90	10:33 am	11/20/90	12:56 pm	0.1638	55381	618	55.1
NU7-20429	11/15/90	12:20 pm	11/16/90	10:34 am	11/20/90	01:06 pm	0.1638	39554	618	39.2
NU7-20430	11/15/90	12:12 pm	11/16/90	10:35 am	11/20/90	01:18 pm	0.1638	41457	618	41.0
NU7-20431	11/15/90	12:24 pm	11/16/90	10:34 am	11/20/90	01:30 pm	0.1638	46276	618	46.3
NU7-20432	11/15/90	12:28 pm	11/16/90	10:32 am	11/20/90	01:41 pm	0.1638	84987	618	85.9

**NOTE:** All times are local stack times; Counting time is /O minutes; Flux is given in pCi/Sec-Sq M  
**NOTE:** Number of Flux Measurements = 12; Average flux = 47.7



**SCIENTIFIC ANALYSIS, INC.**

**U.S. EPA LISTED  
RADON LABORATORY**

**SUMMARY OF RADON FLUX COMPUTATIONS  
TABLE Td. DUPLICATE TEST RESULTS FOR TOP OF STACK  
Scientific Analysis, Inc.; Montgomery, Alabama 36117**

**11/27/90**

Detector	---- On Stack -----	--- Off Stack ----	-- Count Begun ---	Counter Eff.	Gross Cnts	Background	Flux
WU7-20430	11/15/90 12:12 pm	11/16/90 10:35 am	11/21/90 12:02 pm	0.1642	35074	634	40.9

**NOTE: All times are local stack times; Counting time is 10 minutes; Flux is given in pCi/Sec-Sq M**

**NOTE: Number of Flux Measurements = 1; Average flux = 40.9**



**SCIENTIFIC ANALYSIS, Inc.**

**U.S. EPA LISTED  
RADON LABORATORY**

**SUMMARY OF RADON FLUX COMPUTATIONS  
TABLE Tb. BLANK TEST RESULTS FOR TOP OF STACK  
Scientific Analysis, Inc.; Montgomery, Alabama 36117**

**11/27/90**

Detector	---- On Stack -----	--- Off Stack ----	-- Count Begun ---	Counter Eff.	Gross Cnts	Background	Flux
NU7-20433	11/15/90 12:15 pm	11/16/90 10:30 am	11/20/90 01:52 pm	0.1638	622	618	0.0

**NOTE: All times are local stack times; Counting time is 10 minutes; Flux is given in pCi/Sec-Sq M**

**NOTE: Number of Flux Measurements = 1; Average flux = 0.0**



SCIENTIFIC ANALYSIS, INC.

CHAIN OF CUSTODY RECORD

Radon Flux Testing

Job Name: Ecology & Environment - Navajo Uranium mine Sites

Samplers (Name and Signature): Mary Sue Philp [Signature]

Beverly Pester [Signature]

Sample Locations/Sample ID Numbers (Collector Numbers):

#20384 to #20433

Sample Type: Exposed Charcoal in Plastic Container

Total Number of Samples: 50

Collection Date: 11/15/90 to 11/16/90

Relinquished By (Name and Signature): Mary Sue Philp

Date/Time:

11/16/90

Received By (Name and Signature): Faith Ann McWhorter

Date/Time:

11-19-90 10:00 am

Relinquished By (Name and Signature):

Date/Time:

Received By (Name and Signature):

Date/Time:

APPENDIX B

01/21/91 15:49:23

REPORT TMA Eberline Corporation  
TO 5635 Jefferson Street NE  
Albuquerque, NM 87109

PREPARED Thermo Analytical, Inc.  
BY 160 Taylor Street  
Monrovia, CA 91016

ATTEN Rick Haaker

ATTEN Ms. Carole Harris  
PHONE 818-357-3247

CERTIFIED BY Wells

CONTACT REM

CLIENT TMA EBERLINE SAMPLES 28  
COMPANY TMA Eberline Corporation  
FACILITY Albuquerque, NM

This report is for the sole and exclusive use of the client to whom it is addressed and represents only those samples herein described. Samples not destroyed in testing are retained a maximum of 30 days unless otherwise requested.

WORK ID E & E  
TAKEN By TMA Staff  
TRANS By UPS  
TYPE Solid & Liquids  
P.O. # Verbal - Dennis Wells  
INVOICE under separate cover

### SAMPLE IDENTIFICATION

01 01A  
01 01A duplicate  
01 01A Spike  
01 01A Spike Duplicate  
02 02A  
03 03A  
04 04A  
05 05A  
06 06A  
07 07A  
08 08A  
09 09A  
10 10A  
11 11A  
12 12A  
13 13A  
14 14A  
15 15A  
16 16A  
17 17A  
18 18A

### TEST CODES and NAMES used on this workorder

3050IC Strong Acid Dig.-Tot. Met.  
AS L Arsenic - Liquids  
AS S Arsenic - Solids  
AS SED As/Se Digestion  
METALS METALS ANALYSIS  
MPREPS Metals Prep. - Solid  
MPREPW Metals Prep. - Liquid  
PB LF Lead by HGF  
PB SF Lead by HGF  
SE L Selenium - Liquids  
SE S Selenium - Solid  
SR L Strontium - Liquids  
SR S Strontium - Solids  
ZR L Zirconium - Liquids  
ZR S Zirconium - Solids

Page 2  
Received: 12/06/90

TMA Inc. REPORT  
01/21/91 15:49:23

Work Order # A0-12-025

### SAMPLE IDENTIFICATION

19	19A
20	20A
21	21A
22	W1
22	W1 Dulpicate
22	W1 Spike
22	W1 Spike Duplicate
23	W2
24	W3
24	W4
26	W5
27	W6
28	W7

Page 3  
Received: 12/06/90

TMA Inc.

REPORT

Work Order # A0-12-025

Results by Sample

SAMPLE ID 01A AREA 20

FRACTION 01A TEST CODE METALS NAME METALS ANALYSIS

Date & Time Collected 11/14/90

Category

AREA

Date Prepared 12/20/90

Date Analyzed 01/07/91

Analytical Test Results - METALS

Analyst REM	UNITS	mg/Kg	
ELEMENT	METHOD	RESULT	DETECTION LIMIT
Chromium	ICP	ND	2
Vanadium	ICP	474.	3
Titanium	ICP	26.	1
Magnesium	ICP	2770.	22
Manganese	ICP	260.	1
Barium	ICP	221.	1
Aluminum	ICP	4107.	3
Molybdenum	ICP	ND	4
Arsenic	FURNACE	1. 6	0. 1
Selenium	FURNACE	0. 9	0. 2
Strontium	FLAME	150.	5
Lead	FURNACE	17. 9	0. 1

Received: 12/06/90

TMA Inc.

REPORT

Work Order # A0-12-025

## Results by Sample

SAMPLE ID 01A duplicate Area 20

FRACTION 01B TEST CODE METALS NAME METALS ANALYSIS

Date &amp; Time Collected 11/14/90

Category

Date Prepared 12/20/90

Date Analyzed 01/07/91

## Analytical Test Results - METALS

Analyst REM

UNITS

mg/Kg

ELEMENT

METHOD

RESULT

DETECTION  
LIMIT

Chromium

ICP

ND

2

Vanadium

ICP

465.

3

Titanium

ICP

9.

1

Magnesium

ICP

1860.

22

Manganese

ICP

250.

1

Barium

ICP

154.

1

Aluminum

ICP

3360.

3

Molybdenum

ICP

ND

4

Arsenic

FURNACE

1.8

0.1

Selenium

FURNACE

1.9

0.2

Strontium

FLAME

180.

5

Lead

FURNACE

14.4

0.1

Received: 12/06/90

TMA Inc.

REPORT

Work Order # A0-12-025

Results by Sample

SAMPLE ID 01A Spike

FRACTION 01C TEST CODE METALS NAME METALS ANALYSIS

Date &amp; Time Collected 11/14/90

Category

Date Prepared 12/20/90

Date Analyzed 01/07/91

## Analytical Test Results - METALS

Analyst REM	UNITS	mg/Kg	
ELEMENT	METHOD	RESULT	DETECTION LIMIT
Chromium	ICP	137.	2
Vanadium	ICP	738.	3
Titanium	ICP	139.	1
Magnesium	ICP	4130.	22
Manganese	ICP	453.	1
Barium	ICP	368.	1
Aluminum	ICP	12300.	3
Molybdenum	ICP	154.	4
Arsenic	FURNACE	NA	0.1
Selenium	FURNACE	NA	0.2
Strontium	FLAME	NA	5
Lead	FURNACE	NA	0.1

Received: 12/06/90

TMA Inc.

REPORT

Work Order # A0-12-025

Results by Sample

SAMPLE ID 01A Spike Duplicate

FRACTION 01D TEST CODE METALS NAME METALS ANALYSIS

Date &amp; Time Collected 11/14/90

Category

Date Prepared 12/20/90

Date Analyzed 01/07/91

## Analytical Test Results - METALS

Analyst REM

UNITS

mg/Kg

ELEMENT

METHOD

RESULT

DETECTION  
LIMIT

Chromium

ICP

139.

2

Vanadium

ICP

791.

3

Titanium

ICP

97.

1

Magnesium

ICP

4540.

22

Manganese

ICP

461.

1

Barium

ICP

408.

1

Aluminum

ICP

13950.

3

Molybdenum

ICP

150.

4

Arsenic

FURNACE

NA

0.1

Selenium

FURNACE

NA

0.2

Strontium

FLAME

NA

5

Lead

FURNACE

NA

0.1

Page 7  
Received: 12/06/90

TMA Inc. REPORT  
Results by Sample

Work Order # A0-12-025

SAMPLE ID 02A Area 22

FRACTION 02A TEST CODE METALS NAME METALS ANALYSIS  
Date & Time Collected 11/14/90 Category

Date Prepared 12/20/90  
Date Analyzed 01/07/91

Analytical Test Results - METALS

Analyst REM

UNITS

mg/Kg

ELEMENT

METHOD

RESULT

DETECTION  
LIMIT

Chromium  
Vanadium  
Titanium  
Magnesium  
Manganese  
Barium  
Aluminum  
Molybdenum  
Arsenic  
Selenium  
Strontium  
Lead

ICP  
ICP  
ICP  
ICP  
ICP  
ICP  
ICP  
ICP  
FURNACE  
FURNACE  
FLAME  
FURNACE

NA  
105.  
20.  
1300.  
146.  
86.2  
2120.  
ND  
0.8  
<0.2  
162.  
4.1

2  
3  
1  
22  
1  
1  
3  
4  
0.1  
0.2  
5  
0.1

Received: 12/06/90

Results by Sample

SAMPLE ID 03A Area 23

FRACTION 03A TEST CODE METALS NAME METALS ANALYSIS

Date &amp; Time Collected 11/14/90

Category

Date Prepared 12/20/90

Date Analyzed 01/07/91

## Analytical Test Results - METALS

Analyst REM	UNITS	mg/Kg	
ELEMENT	METHOD	RESULT	DETECTION LIMIT
Chromium	ICP	ND	2
Vanadium	ICP	53.4	3
Titanium	ICP	15.0	1
Magnesium	ICP	793.	22
Manganese	ICP	151.	1
Barium	ICP	106.	1
Aluminum	ICP	1830.	3
Molybdenum	ICP	ND	4
Arsenic	FURNACE	0.7	0.1
Selenium	FURNACE	<0.2	0.2
Strontium	FLAME	103.	5
Lead	FURNACE	4.1	0.1

Received: 12/06/90

TMA Inc.

REPORT

Work Order # A0-12-025

Results by Sample

SAMPLE ID 04A Area 25

FRACTION 04A TEST CODE METALS NAME METALS ANALYSIS

Date &amp; Time Collected 11/14/90

Category

Date Prepared 12/20/90

Date Analyzed 01/07/91

## Analytical Test Results - METALS

Analyst REM

UNITS

mg/Kg

ELEMENT

METHOD

RESULT

DETECTION  
LIMIT

Chromium

ICP

ND

2

Vanadium

ICP

8.28

3

Titanium

ICP

10.8

1

Magnesium

ICP

612.

22

Manganese

ICP

142.

1

Barium

ICP

76.4

1

Aluminum

ICP

1240.

3

Molybdenum

ICP

ND

4

Arsenic

FURNACE

0.5

0.1

Selenium

FURNACE

&lt;0.2

0.2

Strontium

FLAME

24.3

5

Lead

FURNACE

1.7

0.1

Received: 12/06/90

TMA Inc.

REPORT

Work Order # A0-12-025

Results by Sample

SAMPLE ID 05A Area 6

FRACTION 05A TEST CODE METALS NAME METALS ANALYSIS

Date &amp; Time Collected 11/14/90

Category

Date Prepared 12/20/90

Date Analyzed 01/07/91

## Analytical Test Results - METALS

Analyst REM	UNITS	mg/Kg	DETECTION LIMIT
ELEMENT	METHOD	RESULT	
Chromium	ICP	ND	2
Vanadium	ICP	186.	3
Titanium	ICP	52.8	1
Magnesium	ICP	1800.	22
Manganese	ICP	226.	1
Barium	ICP	196.	1
Aluminum	ICP	4210.	3
Molybdenum	ICP	ND	4
Arsenic	FURNACE	0.8	0.1
Selenium	FURNACE	<0.2	0.2
Strontium	FLAME	182.	5
Lead	FURNACE	9.2	0.1

Page 11  
Received: 12/06/90

TMA Inc. REPORT  
Results by Sample

Work Order # A0-12-025

SAMPLE ID 06A *Area 10*

FRACTION 06A TEST CODE METALS NAME METALS ANALYSIS  
Date & Time Collected 11/14/90 Category

Date Prepared 12/20/90  
Date Analyzed 01/07/91

Analytical Test Results - METALS

Analyst REM	UNITS	mg/Kg	
ELEMENT	METHOD	RESULT	DETECTION LIMIT
Chromium	ICP	ND	2
Vanadium	ICP	185.	3
Titanium	ICP	40.	1
Magnesium	ICP	2000.	22
Manganese	ICP	229.	1
Barium	ICP	79.	1
Aluminum	ICP	3640.	3
Molybdenum	ICP	ND	4
Arsenic	FURNACE	0.8	0.1
Selenium	FURNACE	<0.2	0.2
Strontium	FLAME	154.	5
Lead	FURNACE	8.3	0.1

Received: 12/06/90

TMA Inc.

REPORT

Work Order # A0-12-025

Results by Sample

SAMPLE ID 07A Area 11

FRACTION 07A TEST CODE METALS NAME METALS ANALYSIS

Date &amp; Time Collected 11/14/90

Category

Date Prepared: 12/20/90

Date Analyzed 01/07/91

## Analytical Test Results - METALS

Analyst REM

UNITS

mg/Kg

ELEMENT

METHOD

RESULT

DETECTION  
LIMIT

Chromium

ICP

ND

2

Vanadium

ICP

847.

3

Titanium

ICP

15.9

1

Magnesium

ICP

2580.

22

Manganese

ICP

273.

1

Barium

ICP

200.

1

Aluminum

ICP

4320.

3

Molybdenum

ICP

ND

4

Arsenic

FURNACE

1.7

0.1

Selenium

FURNACE

&lt;0.2

0.2

Strontium

FLAME

15.3

5

Lead

FURNACE

26.6

0.1

Received: 12/06/90

TMA Inc.

REPORT

Work Order # A0-12-025

Results by Sample

SAMPLE ID 08A Wash S. of  
ResidencesFRACTION 08A TEST CODE METALS NAME METALS ANALYSIS  
Date & Time Collected 11/14/90 Category

Date Prepared 12/20/90

Date Analyzed 01/07/91

## Analytical Test Results - METALS

Analyst REM

UNITS

mg/Kg

ELEMENT

METHOD

RESULT

DETECTION  
LIMITChromium  
Vanadium  
Titanium  
Magnesium  
Manganese  
Barium  
Aluminum  
Molybdenum  
Arsenic  
Selenium  
Strontium  
LeadICP  
ICP  
ICP  
ICP  
ICP  
ICP  
ICP  
ICP  
FURNACE  
FURNACE  
FLAME  
FURNACE  
ND  
9.63  
25.3  
1154.  
105.  
58.5  
2970.  
ND  
1.4  
0.2  
25.5  
21.92  
3  
1  
22  
1  
1  
3  
4  
0.1  
0.2  
5  
0.1

Received: 12/06/90

TMA Inc.

REPORT

Work Order # AW-12-025

Results by Sample

SAMPLE ID 09A Road to B-V

FRACTION 09A TEST CODE METALS NAME METALS ANALYSIS

Date &amp; Time Collected 11/14/90

Category

Date Prepared 12/20/90

Date Analyzed 01/07/91

## Analytical Test Results - METALS

Analyst REM	UNITS	mg/Kg	DETECTION LIMIT
ELEMENT	METHOD	RESULT	
Chromium	ICP	ND	2
Vanadium	ICP	6.07	3
Titanium	ICP	25.1	1
Magnesium	ICP	1480.	22
Manganese	ICP	2580.	1
Barium	ICP	4930.	1
Aluminum	ICP	3060.	3
Molybdenum	ICP	ND	4
Arsenic	FURNACE	0.8	0.1
Selenium	FURNACE	<0.2	0.2
Strontium	FLAME	35.1	5
Lead	FURNACE	3.9	0.1

Received: 12/06/90

TMA Inc.

REPORT

Work Order # A0-12-025

## Results by Sample

SAMPLE ID 10A On Road to  
DesiderioFRACTION 10A TEST CODE METALS NAME METALS ANALYSISDate & Time Collected 11/15/90

Category \_\_\_\_\_

Date Prepared 12/20/90Date Analyzed 01/07/91

## Analytical Test Results - METALS

Analyst REM

UNITS

mg/Kg

ELEMENT

METHOD

RESULT

DETECTION  
LIMIT

Chromium

ICP

ND

2

Vanadium

ICP

10.4

3

Titanium

ICP

90.3

1

Magnesium

ICP

2170.

22

Manganese

ICP

181.

1

Barium

ICP

124.

1

Aluminum

ICP

5530.

3

Molybdenum

ICP

ND

4

Arsenic

FURNACE

1.8

0.1

Selenium

FURNACE

&lt;0.2

0.2

Strontium

FLAME

22.6

5

Lead

FURNACE

5.9

0.1

Received: 12/06/90

TMA Inc.

REPORT

Work Order # A0-12-025

## Results by Sample

SAMPLE ID 11A *Mine Pit Near*  
*Corral*

FRACTION 11A TEST CODE METALS NAME METALS ANALYSIS

Date &amp; Time Collected 11/15/90

Category

Date Prepared 12/20/90

Date Analyzed 01/07/91

## Analytical Test Results - METALS

Analyst REM

UNITS

mg/Kg

ELEMENT

METHOD

RESULT

DETECTION  
LIMIT

Chromium

ICP

ND

2

Vanadium

ICP

5.67

3

Titanium

ICP

41.3

1

Magnesium

ICP

2150.

22

Manganese

ICP

148.

1

Barium

ICP

91.0

1

Aluminum

ICP

3970.

3

Molybdenum

ICP

ND

4

Arsenic

FURNACE

0.1

0.1

Selenium

FURNACE

&lt;0.2

0.2

Strontium

FLAME

64.0

5

Lead

FURNACE

2.4

0.1

Page 17  
Received: 12/06/90

TMA Inc. REPORT  
Results by Sample

Work Order # A0-12-025

SAMPLE ID 12A *Radon*  
*Cartridge Area*

FRACTION 12A TEST CODE METALS NAME METALS ANALYSIS  
Date & Time Collected 11/15/90 Category

Date Prepared 12/20/90  
Date Analyzed 01/07/91

Analytical Test Results - METALS

Analyst REM	UNITS	mg/Kg	
ELEMENT	METHOD	RESULT	DETECTION LIMIT
Chromium	ICP	ND	2
Vanadium	ICP	11.0	3
Titanium	ICP	23.1	1
Magnesium	ICP	2450.	22
Manganese	ICP	136.	1
Barium	ICP	132.	1
Aluminum	ICP	4000.	3
Molybdenum	ICP	ND	4
Arsenic	FURNACE	5.2	0.1
Selenium	FURNACE	<0.2	0.2
Strontium	FLAME	116.	5
Lead	FURNACE	9.5	0.1

Received: 12/06/90

TMA Inc.

REPORT

Work Order # A0-12-025

Results by Sample

SAMPLE ID 13A Radon Cart Area

FRACTION 13A TEST CODE METALS NAME METALS ANALYSIS

Date &amp; Time Collected 11/15/90

Category

Date Prepared 12/20/90

Date Analyzed 01/07/91

## Analytical Test Results - METALS

Analyst REM	UNITS	mg/Kg	
ELEMENT	METHOD	RESULT	DETECTION LIMIT
Chromium	ICP	ND	2
Vanadium	ICP	12.7	3
Titanium	ICP	39.8	1
Magnesium	ICP	2440.	22
Manganese	ICP	245.	1
Barium	ICP	104.	1
Aluminum	ICP	3720.	3
Molybdenum	ICP	ND	4
Arsenic	FURNACE	10.2	0.1
Selenium	FURNACE	<0.2	0.2
Strontium	FLAME	139.	5
Lead	FURNACE	7.0	0.1

Page 19  
Received: 12/05/90

TMA Inc. REPORT  
Results by Sample

Work Order # A0-12-025

SAMPLE ID 14A Station 11

FRACTION 14A TEST CODE METALS NAME METALS ANALYSIS  
Date & Time Collected 11/15/90 Category

Date Prepared 12/20/90  
Date Analyzed 01/07/91

Analytical Test Results - METALS

Analyst RPN

UNITS

mg/Kg

ELEMENT

METHOD

RESULT

DETECTION  
LIMIT

Chromium  
Vanadium  
Titanium  
Magnesium  
Manganese  
Barium  
Aluminum  
Molybdenum  
Arsenic  
Selenium  
Strontium  
Lead

ICP  
ICP  
ICP  
ICP  
ICP  
ICP  
ICP  
ICP  
FURNACE  
FURNACE  
FLAME  
FURNACE

ND  
11.2  
55.1  
2049.  
131.  
69.7  
4000.  
ND  
1.4  
0.2  
119.  
3.3

2  
3  
1  
22  
1  
1  
3  
4  
0.1  
0.2  
3  
0.1

Received: 12/06/90

TMA Inc.

REPORT

Work Order # A0-12-025

## Results by Sample

SAMPLE ID 15A

FRACTION 15A TEST CODE METALS NAME METALS ANALYSIS

Date &amp; Time Collected 11/15/90

Category

Date Prepared 12/20/90

Date Analyzed 01/07/91

## Analytical Test Results - METALS

Analyst REM

UNITS

mg/Kg

ELEMENT

METHOD

RESULT

DETECTION  
LIMIT

Chromium  
Vanadium  
Titanium  
Magnesium  
Manganese  
Barium  
Aluminum  
Molybdenum  
Arsenic  
Selenium  
Strontium  
Lead

ICP ND  
ICP 9.43  
ICP 60.1  
ICP 2130.  
ICP 137.  
ICP 58.4  
ICP 4370.  
ICP ND  
FURNACE 1.5  
FURNACE <0.2  
FLAME 129.  
FURNACE 3.1

2  
3  
1  
22  
1  
1  
3  
4  
0.1  
0.2  
5  
0.1